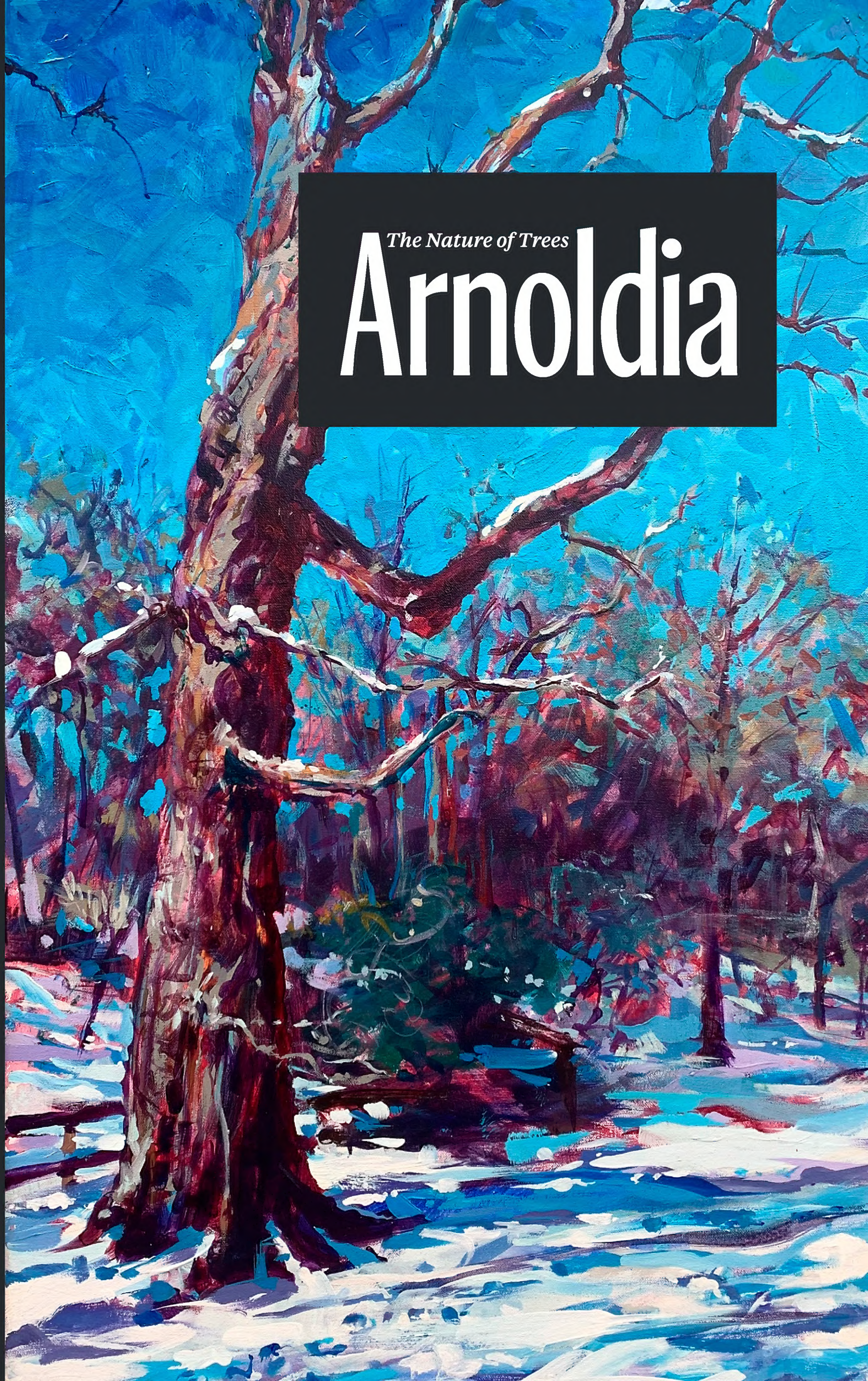


Arnoldia

The Nature of Trees

WINTER 2024

Trees as Living Fossils

Unexpected Resilience

Metasequoia Type Specimen

Field Guides and Feel Guides

Trees as Law

The Seed in Winter

By Matthew Battles

It's been a dappled autumn, a strange swirl of bright foliage and summer-warm days, with little of the gray-drawn drear of winter's doorway in it. And yet, while the numbers on the weather app scramble, the sky still signals the coming winter—reliably, as Orion rears up in the evening dark, and also surprisingly, as the occasional flare of the aurora has played trickster-like across our skies. We're in a time of disordered signs. But then, the seasons always have interwoven—there's a bit of spring still at work in fall's coloring leaves, as they reveal the relict pigments that had protected them when they first broke bud with the increase of light. Just as last spring, I felt autumn's swoon as the brown-spotted blossoms flew from the magnolias, and winter under a snow of white flowers—

> *How long would it take*
> *this brave breeze to bury me*
> *in cherry petals?*

More recently, on the evening of November 5, I started for home across the landscape through the season's newfound dark—the fallback hour always a surprise, not only shifting sunrise and sunset, but altering the character of the light at every hour. An evening of unsettling warmth in that wintry light, which as I passed out of the willows and into the maples ripened and softened into a twilight of such sweetness: the moon's fine smile fogged as if it were breathing on the dome of the sky; a west-going flash of contrail, which spread and evaporated like a ribbon of pigment draped into water. Out on the Arborway, the traffic spasmed; I could feel as much as hear the throb and tumult of the city churning around the station over the hill. I didn't want to go down into it, and so I paused along the path where the quinces and medlars clasp their wintering fruits against the winds to come. I watched as the troughs of the clouds lifted the going blush of sun, and bats rowed out among the inky crowns of the trees, dipping for insects in eddies of air.

And now, while frost has yet to settle in the night, I see winter not only in the sky, but also in the fringes and pompoms of seeds bobbing at the meadow's edge—the long, broken wands of goldenrod and the glassine tufts of the asters, all fringed with the seed-fluff that lofts with the winter's early winds. I'm watching the milkweeds, too—their seed pods burst, their silken linings unraveling, like so many tiny parkas unzipped and blown open by the intrusive wind.

In his late writings, Henry David Thoreau devoted himself with passionate precision to looking at nature, and the milkweed's habits entranced him. As his illness advanced—he would die from tuberculosis in 1862, in the early darkness of the Civil War—he seemed in a panic to learn "the language of these fields" while he still was able. At the same time, he worried that "in exchange for views as wide as heaven's cope, I am being narrowed down to the field of the microscope. I see details, not wholes nor the shadow of the whole." By 1860, however, Thoreau had begun to reconcile the magnitudes of microscope and heaven's cope. He finds the early-November goldenrods and asters "richly and exuberantly downy," their seed "so fine that when we jar the plant and set free a thousand, it is with great difficulty that we detect them in the air." Here at the edge of visibility, at the threshold of microscope and heaven's cope, he begins to discover presence and possibility. The seeds of milkweed in particular give him the amplitude he is looking for, as he zooms from the minuscule scale of seed-sails to the landscape mileage the windblown seeds would clock. Thoreau notes how the milkweed's pods crack open to reveal the seeds with their "thin, silvery parachutes like the finest unsoiled silk," which soon detach to become "the buoyant balloon which, like some spiders' webs, bears the seeds to new and distant fields." To Henry, these seeds are imbued with wanderlust and ambition: a seed hangs on the lip of a recently burst pod like "a vessel moored with long cables and lying in the stream, prepared to spread her sails and depart any moment." As he sifts the seeds from burst pods along Clematis Brook, he watches as their silk threads "fly apart at once, opening with a spring—

> I let one go ... I fear it will make shipwreck against the neighboring wood..... Feeling the strong north wind, it is borne off rapidly in the opposite direction, over Deacon Farrar's woods, ever rising higher and higher, and tossing and heaved about with every fluctuation of the air, till at fifty rods off and one hundred feet above the earth, steering south—I lose sight of it.

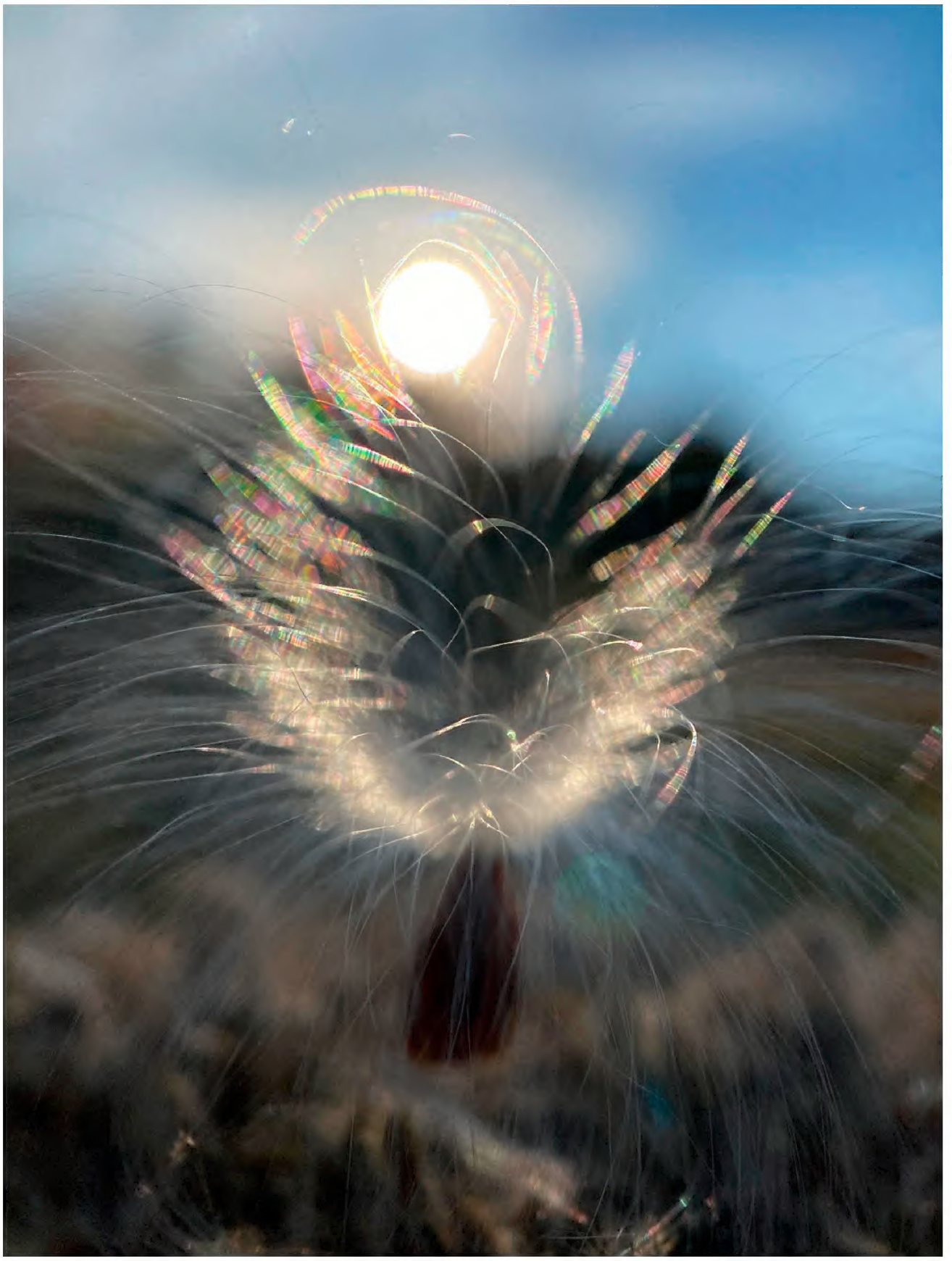
"We find ourselves in a world that is already planted," Thoreau observes, "but is also still being planted as at first."

To Thoreau, the seed is an emigrant, flying off into the swirling night until the air goes still, until it "descries its promised land and settles gently down between the woods ... and its voyage is over." And yet this is only the beginning of another story, Henry reminds us, as the seed "stoops to rise." And so it is the plant that journeys far beyond the scope of the moment: "from generation to generation it goes bounding over lakes and woods and mountains. How many myriads go sailing away thus?"

For an author so fixed and studied in a particular place, Thoreau's disposition toward the end of his life seems to be growing into a metaphysics of dispersal, embracing the risk and uncertainty of dissemination. "We find ourselves in a world that is already planted," Thoreau observes," but is also still being planted as at first."

In the darkness that grows between these plantings, we find our fertility in friends and fellowship. When I shared around some notes about Henry's faith in a seed, my friend Jennifer Roberts, a great scholar of the arts of seeing, responded with pictures she had made of milkweed down—luminous, fragile, and somehow ferocious. One of these pictures radiantly ravels Henry's whole story in a single image—the "prismatic tints" dancing along the silks, alive and spectral; the threads burgeoning and ballooning; and beyond, the soft landscape beckoning and enfolding, Henry's "promised land" of "strange valleys" in whose lees the seed will settle to earth.

Jennifer's images catch the glimmering presence of the life cycle as it abides in the instant, complete and incompletable. "These silken streamers have been perfecting themselves all summer," Henry writes, "a prophecy not only of the fall, but of future springs." A seed, a self—to say there's no knowing what the future holds is a way of acknowledging the wildness, the vastness, of the present moment. The seeds it keeps, treasured in the soil or hidden in the sky,



JENNIFER ROBERTS

radiant as they ride the winds beyond present sight. Even as we know the seed must die into the earth to bring forth its abundance.

Amid the disasters we count and claim, the misfortunes we cast like coins, future flourishings, too, are annealing themselves in the fading light's alchemy. "What is our labor in November now?" asks the writer Nina MacLaughlin, who is the laureate of this month and its light, and whose work helps to close the pages of this issue. "One job: Pay attention. Pay attention. Pay attention. And every year emerge altered, ready, like lead to gold." So pause here at the edge of the path while the dusk arranges itself around your shoulders, while the muffled roar steals into your auricles. Touch the seed-frosted goldenrod, watch those seeds swirl in the air to settle and disappear into the tangle. Sift a few milkweed tufts into the wind. Get intimate with the openness of it, with what my friend and *Arnoldia* contributor Nicholas Anderson calls "the hollowness of this moment" of the seed dispersing. Get in touch with the winter of it, when nothing and everything is happening.

MATTHEW BATTLES *is the editor of* Arnoldia.

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Arboreal codes are alive and well: the Station Oak, marking the boundary of Natick and Weston, MA since 1749, stands tall. *Photograph by Claire Neid*

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Front: *Bur Oak* by Paul Olson, depicting *Quercus macrocarpa* 22891*D along Bridle Path.
Back: The same painting as a work in progress

Inside front and back covers
Art by Shyama Golden

Arnoldia
The Nature of Trees

Volume 81 | Number 4 | 2024

Editor
Matthew Battles

Designer
Andy Winther

Editorial & Production Assistant
Claire Neid

Editorial Committee
Anthony S. Aiello
Yota Batsaki
Peter Del Tredici
Michael S. Dosmann
Rosetta Elkin
William (Ned) Friedman
Jon Hetman
Jonathan Shaw

Creative Consultants
Point Five

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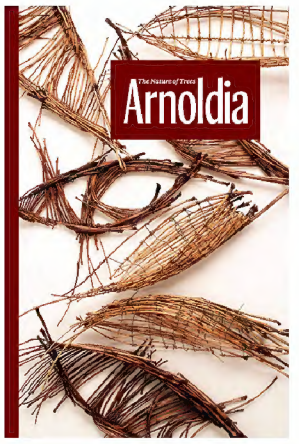

Arnoldia welcomes your ideas, questions, and feedback. Letters should be sent with the writer's name, address, and phone number via email to arnoldia@arnarb.harvard.edu. Letters may be edited for length and clarity.

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Joy in Learning

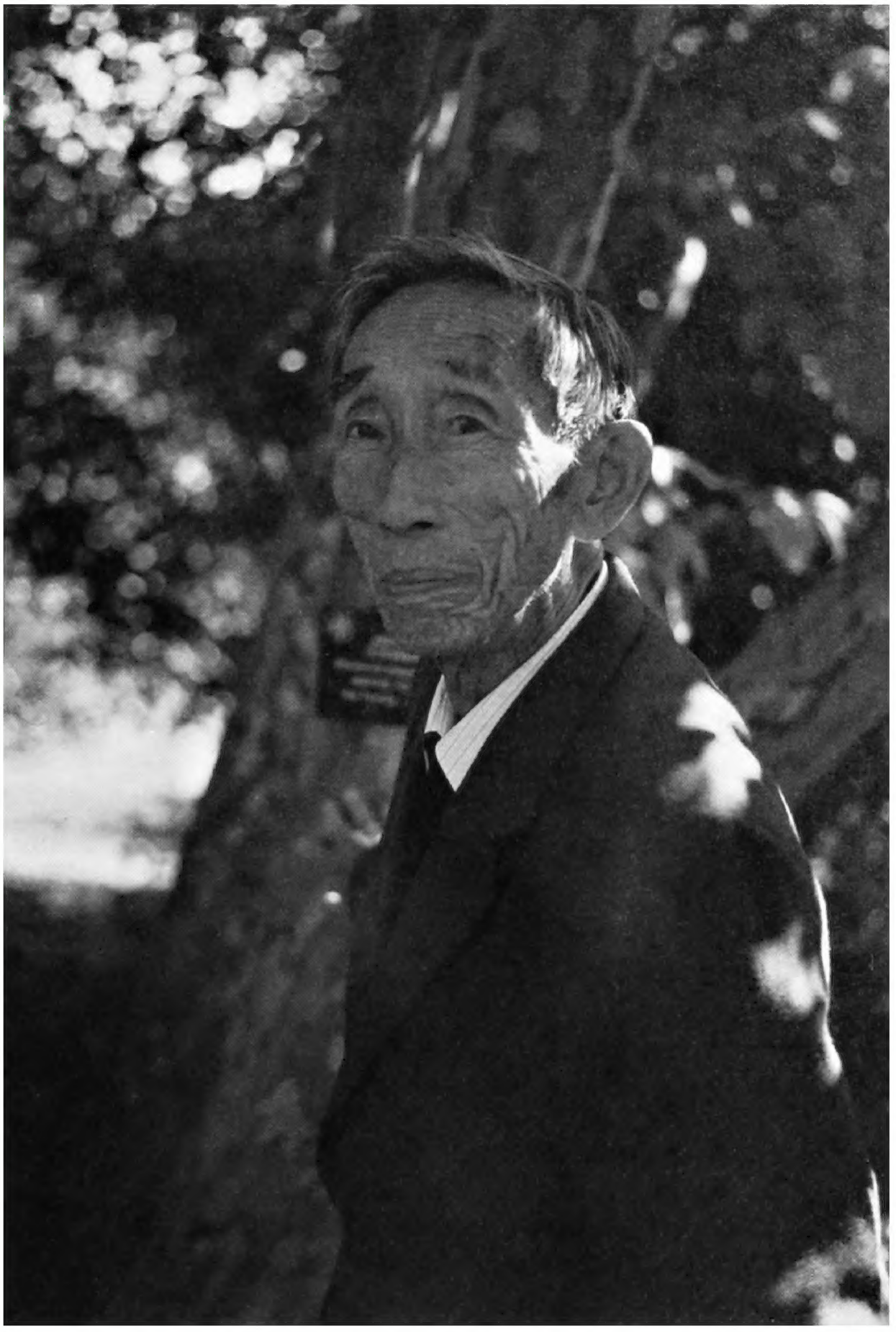
Thank you and your staff for the wonderful summer issue of *Arnoldia;* The cover images and inside pages by Leah Sobsey and Robin Vuchnich are especially memorable. Thank you for including the poem by Emily Dickinson. I was so glad to see the "Congratulations to Rachel May" because I had loved her article about the white oak ("The White Oak Tree at McLean: a Case of Recovery") in the Winter 2023 issue.

It is hard to single out any one aspect of this journal that never disappoints. I say that from my point of view as an artist with no special knowledge of trees but with a joy in learning through the offerings of the Arboretum. My family (David Rubin, Anna Rubin and I) walk there almost every Sunday year-round no matter what the weather. (This past rainy Sunday was no exception).

All my best,

Eleanor Rubin
June 10, 2024

*Editor's note: The online (PDF) version of "Wilderness in History and Ecology" by Edward K. Faison (*Arnoldia *81:3 Fall 2024) has been corrected to update several citations that appear in the print edition. The corrected online edition of the article will appear via arboretum.harvard.edu and research library databases after embargo and is available upon request.*



Chi-Ju Hsueh (Xuē Jì Rú 薛纪如, 1921–1999) on a visit to the Arboretum in 1996. Hsueh made crucial early collections from the *Metasequoia* type tree.
See page 22

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Notes from the Field

A Branching Dilemma

Delia Mahoney climbs a tree in the beleaguered beech collection, where the traces of decline and hope abound.

Delia Mahoney is an arborist at the Arnold Arboretum.

Hand over hand, my climbing line runs through my fingers, pooling into a neon coil at the roots of the Rohan beech (*Fagus sylvatica 'Rohanii'* 357-49*A). Smooth silver bark flows down the trunk, marred by decades of carved graffiti and lingering disease presence. Above me, fountains of purple foliage shine golden in the afternoon sun, speckled with dark banding also indicative of disease, but of a different sort. This one is new, quick, and devastating.

My task for the day: pruning a freshly broken limb, blown over in a recent windstorm. Winter wind and rainstorms hit this tree hard, each one resulting in a new broken limb. Large portions of the crown are missing, weakened by disease and decay, leaving bright holes of sunlight invading the canopy. I'm lucky to share the stewardship of these trees and the privilege of their maintenance. The resiliency of the trees in this collection is astounding, but each season brings new trials to weather, from pests and diseases to wind damage and drought stress. There are thousands of trees here at the Arboretum, but this is the only one I've climbed repeatedly in my time here. Each ascent of this specimen has been different as branches have been lost, changing my route for every climb. Line over lanyard, I

Illustrations by Matt Huynh

explore today's version of this tree, discovering new patches of decay and revisiting old familiar pruning cuts.

This beech is one of 102 growing in the Arboretum as part of the *Fagus* collection; a grouping of plants concentrated on the southeast side of Bussey Hill, running downslope toward South Street. Over the last century and a half, many of these *Fagus* specimens grew to be among the largest trees in the Arboretum—many of them with lush green foliage, spreading branches, and stately trunks rivaling the size of the well-known silver maple (*Acer saccharinum,* 12560*C) that presides over Meadow Road.

I'm lucky to share the stewardship of these trees and the privilege of their maintenance.

But the very characteristics that define the beeches are the same ones responsible for its downfall. The smooth gray bark, signature of the genus, is attractive not just to humans with pocket knives, but also to several insect species. Two scale insects, one native and one introduced, are known to wound the trunk and branches of *Fagus* species while feeding. These insects use a stylet and their mouthparts to pierce the bark and extract fluids from the tree. The wounds, whether human or insect in origin, are then colonized by fungal pathogens (*Neonectria ditissima* or *N. faginata*). The fungus invades the bark of the tree, forming cankers that disrupt the tree's vascular system and the vital processes within. This insect and fungal pattern forms the disease complex known as Beech Bark Disease (BBD).

Beech bark disease threatens not only our prized landscape specimens, but also forest ecosystems across the Northeast. *Fagus grandifolia,* the American beech, comprises a significant portion of the mature tree biomass in Massachusetts, and is a keystone species across its native range. BBD has been documented at the Arboretum for nearly a century. Large-scale removals were performed in recent decades by the arborist crew in response to the decline and devastation following the advancing disease front. The disease still lingers in many plantings throughout the Arboretum.

As I move away from the main trunk, navigating along a large lateral branch, I

SMALL WORLD

Extending limbs toward language revitalization

Each specimen in the Arnold Arboretum displays a metal tag the size of a credit card, which provides its common and scientific names, collection data, and accession information. In northern Kenya, similar metallic sheets are affixed to young wild olive and cedar trees by students in the Mukogodo Forest as part of a "word forest" movement. An October article from the *Guardian* explores the efforts of Yaaku teacher, Juliana Loshiro, as she endeavors to revitalize and preserve her language and culture through tagging trees with their Yaakunte and English names. This movement reflects those of many Indigenous communities across the world fighting to save their languages, cultures, and ways of knowing. The safeguarding of Indigenous knowledge through language revitalization is crucial, as Loshiro says, "[i]f we lost the language, we have lost the culture, we have lost the forest." In hopeful contrast, Loshiro describes, "[a]s the trees grow, the language grows."

GOOGLE MAPS

In the vicinity of Kenya's Mukogodo Forest.

notice symptoms of BBD in the Rohan beech. Other colonies of wood-decay fungi form a colorful patchwork throughout the scaffold branches, a worrying sight as I entrust the support of my life to these limbs. The branch union I've selected to tie my climbing line through is sturdy, and free of fungal fruiting bodies, indicating a healthier portion of the tree canopy. Still, I move deliberately along the branch toward my target, the broken limb hung up in the still-standing branches of the tree. I'm aware of the force my movement exerts on the tree, the push of my weight and opposing pull of my climbing system.

Passing through the lateral branches and over burgeoning sprouts, I take note of the condition of the leaves, some of the most distinctive in form among within the genus *Fagus*. Its foliage a rich, dark purple tinged with crimson at the tips, this cultivar of European beech (*Fagus sylvatica*) is known for its spectacular color. Looking through the canopy, the sunlight illuminates each leaf, highlighting the deep color and revealing an unsettling pattern: dark bands striping each leaf. This symptom is the signature of beech leaf disease (BLD), a novel pathogen that has rocked the Eastern United States in the last decade.

In 2012, foresters in Ohio first noticed this dark banding in the canopies of American beech stands. These symptoms spread quickly east across the United States as scientists and researchers worked to uncover the cause behind the symptoms. The causal agent is now known to be a foliar nematode in the family *Anguinidae,* classified as *Litylenchus crenata mccannii*. In the last decade, the nematode and accompanying symptoms have been detected across the northeast US and into parts of Canada. The rate of spread of the disease is unprecedented and the devastation left behind is extreme. Mature forest stands and landscape plantings have experienced heavy loss in as few as five years, and treatment options remain elusive. Symptoms were first observed at the Arboretum in 2022, and now the disease affects most of the *Fagus* collection, particularly the American and European species.

Beech bark disease threatens not only our prized landscape specimens, but also forest ecosystems across the Northeast.

Many of the beech plantings at the Arboretum were already suffering from beech-bark disease and environmental stress, and the destruction caused by beech leaf disease has been swift. The novelty of the disease has been a particular challenge in discovering management and preservation options for this prized collection—it is one of eight Nationally Accredited Collections in the Arnold. This particular Rohan beech was part of a trial exploring new management strategies for the disease. Several plantings in the collection received a novel chemical treatment, and we await results early in the next growing season.

Reaching the conclusion of my limb-walk, I begin to untangle the hanging storm break from the remaining live growth. Bracing my feet on a branch, I unhook the chainsaw from my climbing saddle and, with a signal to my coworkers, begin the final cut to clean the broken spear of wood from which the limb broke. After stowing the saw once again, I start my traverse back to the trunk, picking my way back along the branch, careful not to damage the numerous shoots sprouting up. This tree, like so many others in the *Fagus* collection and beyond, needs every chance for success, and every twig is another bid for survival. Tending my line, controlling my descent along the trunk, I wonder when the next time will be that I visit this tree.

WELL SAID

"Provenance does not dictate our potential, but rather equips us for what prospects may come."

Kim Shearer ponders place, genetic diversity, and future flourishing, in "Unexpected Resilience," page 42.

On the trail to collect *Kirengeshoma palmata*

Michael S. Dosmann and **Chris Copeland** pursue rare yellow waxbells in a magical montane forest, pondering questions that will inform their culture and conservation.

Fresh, cold water spilled from a crack in the earth, and next to the natural bubbler hung several dented, metal cups. Our canteens were mostly full, but the steep hike up the mountain prompted unmet thirst. Also, our Korean colleagues told us the spring's waters possessed qualities that would return us to our youth. Whatever it was we were quenching—perhaps each of us wanting something different—we eagerly dipped the cups and drank deeply.

Just before, we'd been traversing a wooded ridgeline, stepping along a trail that wandered through light forest cover and the occasional clearing wide enough to accommodate a helicopter. To reach the ridge, we'd ascended a series of steep zigzagging trails and rocky ways below the dense forest. The path from the ridge to the magical clearing where the mountain leaked was obvious. Below that point, the vegetation of trees, shrubs, grasses, and vines grew dense due to the rich, rocky, mucky soil and the spring's reward. We plunged ahead eagerly, as our destination was not this fountain of youth but another magical something: *Kirengeshoma palmata*.

No matter how often you've seen a plant in cultivation, seeing it in the wild, in its own raw, unvarnished state, is special. In nature, the plant is stripped away from whatever pampering and primping the gardener gives it. You gain wonderful perspective of what the species and its natural environment amount to. Some plants are resplendent in nature, others demure; others an odd mixture of both. Regardless, these collective insights are invaluable to understanding a species' in-situ proclivities, and can provide keys that unlock the secrets to successful ex-situ cultivation. It is why we collect in the wild, and why we were in the Republic of Korea on an expedition this past September and October. Despite wonderful Arboretum acquisitions from Korea in recent decades, this trip was notable because the last major Arnold Arboretum expedition to Korea was in 1977. We were thrilled to return.

We were just below Baegunsan, a mountain 1222 meters high that lies at the southern edge of the peninsula, not far from the cities of Gwangyang and Suncheon. Besides us, our team comprised Professor Hui Kim of Mokpo University, and Mr. Hak-Gi Park and Mr. Jae-Jun Kim of the nearby Seoul National University's (SNU) Nambu Forest Station. This natural area was under the management of SNU, and Mr. Park is one of the very best experts on the forests' flora, having worked at the site for nearly thirty years. We were in excellent hands.

Why *Kirengeshoma?* Commonly called yellow waxbells, this herbaceous member of the Hydrangeaceae may seem an odd target for an Arnold Arboretum that prides itself in an almost exclusively woody plant

Michael S. Dosmann is the keeper of living collections at the Arnold Arboretum; **Chris Copeland** is the Arboretum's assistant manager of plant production.

Illustration by Matt Huynh

collection. Although the species didn't make it onto the infamous list of 395 targeted desiderata that comprise the Arboretum's Campaign for the Living Collections, the hydrangea family is well represented. The genus is monotypic, with just one species—*Kirengeshoma palmata*—that occurs in the Republic of Korea, Japan, and China. (Note that some recognize plants of Korean provenance as a distinct species, *K. koreana*.) The species possesses great conservation value, being rare regardless of country of origin. Our colleagues at China's Zhejiang University (Professor Li Pan and graduate student Xu-Teng Zhang) are studying the genetic diversity among and across populations in each country. In fact, the two took Michael and assistant curator Miles Sax to one of the populations on China's Tianmushan (Tianmu Mountain) in April 2024. It was during that trip that we decided to collaborate with them further on their research project on this species, acquiring germplasm and genetic samples during our trip to Korea and the 2024 trip to Japan.

While the youthful elixir exerted its effects, we pushed our way through the last of the brush to find ourselves at the upper reaches of the waxbell population. Under dense canopy above, the rounded plants formed mounded clumps, around three feet tall and just a bit wider. Though herbaceous, they masqueraded as woody shrubs in this environment. The broad leaves were large, bigger than one's hand, with wide teeth along tattered margins. They were dull green, rather pockmarked, and had a prominent crisscrossing network of veins. Their coarse appearance contrasted sharply with other shrubs in the area—shiny, elegant, and narrow leaves of *Lindera erythrocarpa;* luscious, lustrous, and large leaves of *Hydrangea macrophylla*. Spotting the ground below were younger waxbell juveniles, just one or two years old, yet just as recognizable as their older kin.

The fruits of *Kirengeshoma* are bizarre. Earlier in the growing season, the yellow and waxy flowers are borne on terminal inflorescences. Each innocuous bloom possesses a delicate beauty, perhaps in part because of the juxtaposition with the rough and grainy foliage. But, we were now looking at the fruits—green balls that each bore several green antenna pointing up and out in several directions. The round seed heads were propped up on firm, wiry stems, as if transmitting radio waves across the forest floor. Were they cosplaying as gigantic ant heads, or rather diminutive extraterrestrials straight out of a 1950s comic strip? Maybe a bit of both. Inside the orbs, we'd find scores of damp, papery, winged seeds, hopefully just ripe enough that they were viable. In another month, the then-dried and opened capsules would start to shed the seeds to the wind.

In the garden, waxbells are placed within the "miffy" category. The species can be needy with respect to requirements. Not too dry; not sopping wet. Never full sun or exposure to the elements; shade is best, but not *too* dark. Oh, and rich, organic soil. With those parameters needed for ideal cultivation, it can be rather easy to predict the native site's characteristics. The plants in this population grew within 15 or so feet

ARNOLDIA CONGRATULATES

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AND

BENJAMIN SWETT

WHOSE ESSAY

"The Loss of an Ailanthus"

(*Arnoldia* volume 80 number 4)

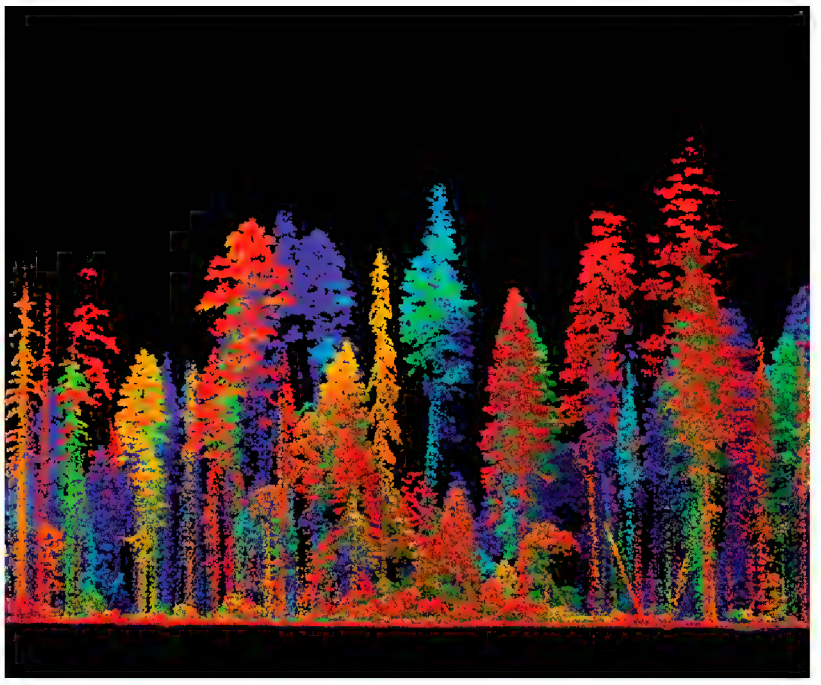
WAS NAMED

Notable in *Best American Essays 2024*

of either side of the mesic seep. It was easy to spot the large, coarse clumps—mature plants as well as smaller, young plants—down the undulating streamside. Even after a dry and stressful Korean summer, the brook raged downhill after plenty of precipitation from the remnants of tropical storm Pulasan. Although the plants' roots anchored them into the soil, they looked shallow enough that during torrential rainfalls the dislodged plants would migrate downslope, just like the papery, winged seeds would later in the season as the wind dispersed them. Perhaps that is a cue to their niche—might they be keyed into that sort of disturbance?

It was not just wet here, but also shady. The shade was provided by oaks (*Quercus mongolica, Q. variabilis*) and maples (*Acer pictum*), and quite a few *Stewartia pseudocamellia*. How often do you get to see this: a rare target species whose preferred habitat, in this population at least, was the understory of multi-stemmed *Stewartia*s, each adorned with light-silver to raspberry-chocolate, patchy bark? Their robust trunks jogged back in forth as if they once dodged the shade in their first years as seedlings. *What might this glade look like earlier in the season?* we wondered. *Do the two species bloom at the exact same time? Do the large, white, fallen blooms of the* Stewartia *scatter about to land on the wide leaves of* Kirengeshoma, *right next to the yellow, waxy bell flowers?* We may need to return next summer to find out.

We surveyed from the top to the bottom of the stretch, taking copious notes and photographs, gathering individuals' leaves for DNA extraction and herbarium vouchers for posterity. We collected a total of sixteen fruits—rounding out our sixteenth collection of the trip—from which to extract seeds. In the steady hands of a propagator, they just might become future seedlings for ex-situ conservation. After wrapping up the last of our samples and gathering up our supplies, we paused to take in this magical spot one last time before we made the ascent past the spring and the ridgeline above.



USGS

ECOLOGIES OF TECHNOLOGY

Deep-mapping biodiversity

While the urgency to meet biodiversity conservation goals is characteristic of the climate crisis, so too is the emergence of ideas and technologies primed to address rapid ecological change. A new study published in *PNAS* addresses one such technology: a deep-learning model called Deepbiosphere, which uses artificial neural networks to analyze and predict plant species distribution. Drawing from satellite imagery and some half million citizen-science observations via the iNaturalist app, researchers focused on the redwood (*Sequoia sempervirens*) forests of coastal California to develop high-resolution plant biodiversity maps of the area—particularly targeting rare and understory species. Though the area had been mapped to record deforestation scars from heavy logging, human annotators failed to detect post clear-cutting secondary-growth redwood forests. When Deepbiosphere mapped the area, it illustrated a much broader distribution of mature and young redwood groves in addition to understory species redwood sorrel (*Oxalis oregana*) and California blackberry (*Rubus ursinus*). Deepbiosphere is part of a shift toward open-source species distribution modeling that—with support from human communities—can help reveal and address ecological changes resulting from anthropogenic activity.

A Scandal in Bee-hemia

When **Brendan Keegan** invites us to help solve an insect murder mystery in the Arboretum's nest boxes, the question of guilt gets complicated.

Imagine being a bumblebee. You spend the night away from your colony, resting underneath a flower. At first light, after a quick sip of nectar, you fly home with your precious cargo of pollen.

Your hive is nestled deep within one of the Arnold Arboretum's bird nest boxes. Inside, your queen mother and sisters should be working tirelessly. But when you arrive, everything is quiet. No sentry perches in the entrance, no one flies in or out.

Upon entering, you immediately notice a silk web obscuring the tunnel. Struggling through the tangling wires, you discover the dripping remains of your colony's precious honeypots. Even worse, something devoured the developing bee larvae!

Fortunately, you find your fellow workers and your queen mother. Unfortunately, it's only piles of their decapitated bodies and inedible appendages. An ominous munching sound suddenly fills the air ...

On second thought, let's not imagine being a bumblebee. Instead, join the case as an entomological private eye. What happened to this colony? Who did it? Will the culprit strike again? The game, as they say, is on.

A Study in Nest Site Selection

In this case, our victim was a colony of *Bombus impatiens,* the common eastern bumblebee. You interview the sole surviving worker bee, who confirms that the colony started in early May. By June, her sisters filled the air, coming and going every few seconds with pollen and nectar. By August, all are dead.

While you talk with our witness, I hastily investigate the crime scene and discover the

Brendan Keegan is a horticulturist at the Arnold Arboretum.

Illustration by Matt Huynh

colony is nestled in a black-capped chickadee nest. Chickadees build warm, cozy nests made of moss, animal fur, and fungi. Queen bumblebees use this warm environment for insulating their own families. Despite her small size, a determined queen bee can scare off the much larger chickadees and claim the site for herself.

But nest-site selection carries risks. Bumblebees often nest underground in similarly warm old mouse nests. But mice, voles, skunks and other predators hunt for young colonies and eat their protein rich larvae. An elevated tree cavity (or nest box) provides safety from predation. However, height exposes the bees to competition with birds and other insects.

The list of bumblebee predators, competitors, and parasites is very long.

We clearly establish that our victim's colony gambled and lost with site selection. Someone discovered their hiding spot. But who?

A Case of Identity

The list of bumblebee predators, competitors, and parasites is very long. Mites live on their bodies, beetles live in their colonies, birds feast on them in flight, mammals gorge on their larvae. But, fortunately for us, the crime scene helps narrow our choices.

My earlier examination revealed the bird nest material remained mostly intact. This rules out larger predators that would reach in from outside and pull out the contents. From this, you wisely deduce the attack was an inside job. Somone stealthy and small snuck past the sentries and down into nest.

Intriguingly, the killer devoured the colony's wax cells, their contents of pollen, nectar and larvae, and at least a dozen mature bees as well. This implies a varied appetite, and protection from the hostile bees. You pull out the thick mass of silky webbing.

Based on the silk, I conclude the killer is a deadly, bee-eating spider! Not so fast, you say. Instead, you suggest bringing in for questioning that insidious duo of bumblebee enemies, the greater and lesser wax moths. We wait until nightfall, turn on our detective moth light and, along with our witness bee, watch for the usual suspects to arrive.

The Wax-Moth League

Soon enough, the greater wax moth (*Galleria mellonella*) and lesser wax moth (*Achroia grisella*) emerge from the dark. Both species likely originated in Eurasia. However, they are now present globally wherever honeybees are found.

The female moth locates honeybee, bumblebee, and wasp colonies by smell. At night, while the bees rest, she sneaks into the colony and lays her eggs. After hatching, the wax moth caterpillars spin silky tunnels for protection against angry worker bees.

The caterpillars then munch and spin silk throughout the colony, consuming the wax cells used for storing provisions and larvae. Small or weakened bee colonies cannot repair or replace the cells fast enough. These colonies perish.

You recall that greater wax moth caterpillars eat both filled and unfilled wax cells but never the larvae within. Lesser wax moths, on the other hand, primarily consume unused and unoccupied cells. However, if lesser wax moth caterpillars do eat into an occupied cell, they will also eat the contents inside.

We review our suspects' alibis. Greater wax moths might have eaten our victim colony's wax cells, but not their larval contents. But the larvae were clearly eaten. Eager to claim credit, I rush and declare that the lesser wax moth must then be guilty! Its caterpillars overwhelmed the bees, devoured their wax cells, and munched the larvae within. Case closed!

But both you and our surviving witness bee seem unsure, recalling that lesser wax moths prefer southern climates. And something about the crime scene doesn't make sense. Lesser wax moths would eat the larvae, but what about the piles of the consumed bees? You also recall seeing a pad of mysterious cocoons, a clue I failed to spot in my hasty initial inspection ...

Our witness bee notices an unremarkable moth lurking in the shadows of the lamp. Who is this stranger? She taunts us:

How hard do you find it, having to say "I don't know?" Those who enjoy classic bumblebee mysteries can guess the name of our villain. For everyone else, our witness bee screams her name as she escapes into the night: *Aphomia sociella!* European bee moth!

The Sign of the Foreigner

Once considered a Eurasian species, the European bee moth expanded its range globally by the early 1900s, thanks to the human movement of honeybees. Its impact on honeybees is serious but manageable, although infestations in bumblebee colonies nearly always end in collapse.

Like the lesser and greater wax moths, female bee moths find their host colonies by smell. They prefer attacking young colonies, as these have fewer workers and less robust defenses. Relevant to our mystery, the bee moth exclusively attacks elevated nest sites, such as those in trees and nest boxes.

Bee moth caterpillars spin silky defenses and devour both the colony's wax cells as well as the contents inside. As their silk fills the hive, it entangles worker bees, who slowly die of starvation. The queen bumblebee, dependent on her daughters and stored nectar for sustenance, eventually starves as well. The caterpillars then consume the digestible parts of their bodies.

After finishing their meal, the caterpillars spin cocoons and overwinter in the nest. They pack in tight, up to one hundred at a time, creating a distinctive pad. The following spring, adult male and female bee moths emerge, and the entire process begins again.

The Man with the Twisted Lip

Our new suspect in mind, we return to the scene of the crime. We pore over bits and pieces of wax, half-eaten bumblebees, caterpillar frass, a long tunnel of silk. Finally, you pull out the bee moth cocoons and display them for our witness bee's inspection. *Hiding in plain sight,* I exclaim, *the villainous bee moth is the culprit.*

But she is unconvinced. The bee points out that the European bee moth is of course not a villain. The moth's larvae simply do what they must to survive, just like the bees whom they destroy.

On the other hand, she observes, the bee moth would not be here except for the honeybees. Furthermore, honeybees would not be here except for humans. By extension, she accuses us of being accomplices!

I'm irritated by this irrelevant suggestion. I respond that moral hand-wringing over dead bumblebees and moths is pointless. The human role in this event was accidental, likely inevitable, and perhaps, in some distant way, for the best. Bumblebees and moths must adapt or perish, as they have in the past, and so into the future.

Uniting once-separated organisms in a cosmopolitan world is a very messy business.

You kindly acknowledge it is a pity this happened to her colony. Again I interject, arguing that uniting once-separated organisms in a cosmopolitan world is a very messy business. And we are very busy people! No one could have reasonably anticipated her problems, and we are not to blame.

She listens, inspecting the remains of her sisters. Her colony is dead, and so, by extension, is she. Being a bee, she politely says nothing. Suddenly, she flies into the air—and, impolitely, stings me in the lip!

The Final Problem

I rub my swelling face as the bee, killed by her final act, falls lifelessly to the ground. Of course I am angry, but I don't take it personally. After all, she was just a naive bee, over her head in a complicated world. Still, I do feel sorry for her. An unwanted guilt spreads with the injected venom. I know that, unless guilt is rationalized and compartmentalized, it will ooze and fester. So I do my best to ignore it.

But perhaps you can help. You've always been the smarter one, wisely guiding our investigation, correcting my many mistakes. Could she have been right in her own way? Are we humans responsible for our actions towards small things, or for our ignorance? Does the answer even matter? I touch my tender face, a deep burn pulsing. Tell me, did I deserve that sting?

Every Inch of This Place

James Papargiris tells *Arnoldia* about a life in the landscape—what's changed, and what's grown.

What should people know about this place? At the Arnold Arboretum, we ask ourselves some version of this question nearly every day. It's a question best put to the horticultural crew—especially its longest-serving members, like James Papargiris, who recently celebrated his forty-fifth year of service.

Jim joined the crew on September 4th, 1979; he got his first look at the Arboretum that very day, riding through the landscape on the back of a chipper, cleaning up after a big nor'easter. He started his career in landscaping much earlier, however, at the age of 14, doing odd jobs for a local firm in Dedham, where he grew up. "I'd make five bucks in the afternoon sharpening blades," Jim recalls. In a few years, he was the foreman of that crew, having returned to landscape work after getting certified as a front-end auto mechanic. "I didn't like the environment in the garage," he recalls; "in the winter the garage filled with fumes." And then he learned from a neighbor who worked at the Arboretum that they were looking for someone with mechanical skills to help keep the equipment running.

"Back then, the crew was ... not as professional," he says, diplomatically. He filled out a "rudimentary" application—"back then it wasn't as involved"—and he got

> You get to see the changes in trees, and to see the trees you planted grow up.

the job on the spot. Plenty of people had applied, he later found out, but Jim had what the Arboretum needed at that time. "The rest of the crew didn't like me so much, though," he says, "because in the winter I got to work inside. I'd bring in the tractors and do the oil changes, tune them up and things like that." New union contracts, signed in 1986 and '87, were transformative; among other things, licensing and certification became valued. "As I became more proficient in the knowledge of plants, I learned about herbicides; I got my pesticide license, (and) I had more diverse types of work." Versatile and a quick study, Jim moved from Laborer to Skilled Laborer, from Gardener Specialist to Horticultural Technologist, assuming the role of Foreman in 2004. "Now, when new supervisors come in," he notes, "I train them."

In Jim's first years, more than the staffing was different. With fewer crewmembers in the landscape and little by way of public programming, the Arboretum seemed more chaotic and dangerous, with crime, littering, and stolen cars throughout the landscape. Though "as more education and visitation came in," Jim muses, "that kind of (thing) didn't have a place as much." The horticulture could seem more improvisatory, too, judging by today's exacting standards. "When we were planting," Jim recalls, "things went (into the ground) bare root," and without watering; they usually were planted in threes to increase the chances that a single plant would survive. "We'd bring a bunch of plants from

Illustration by Matt Huynh

the greenhouses out to the Case Estates in Weston (an Arboretum nursery from 1942–2015), because it was a zone colder out there—if they survived out there, we'd bring them back and plant them." Today, the plants are raised with great energy and care, watched over and watered, from the time they're propagated. In Jim's early years, the Arboretum's water tank was more important for firefighting than irrigation, with drivers tossing lit cigarettes out of car windows. "If we had a dry July and August, up by Faulkner Hospital in the natural woodlands we'd get fires, and they'd get into the root systems, and a week later they'd come up, and so we used to have overtime for weekend fire patrols."

Pondering our opening question—what should we know about this place?—Jim gets a light in his eyes and a richness comes into his voice. "I know every inch of this place, and it's changed so much, so that's a really hard question. But what I do like is that I can, and to a fault, remember planting certain plants—and now, they're grown up. So, I remember when Gary (Koller) said, 'I don't know if we should plant this, it's a weak plant, maybe we should just discard it,' and I planted it, and now it's a sixty-foot oak. And I've seen half the life of that dawn redwood across the road (from the Hunnewell Building)—I started in '79, it was planted in '49. So, you get to see the changes in trees, and to see the trees you planted grow up, like the *Sequoiadendron* on Bussey Hill; I planted it and it's doing great."

Long service means sowing a rich garden of life, too. Over the course of his career, Jim built a house in Easton, raced sailboats with friends up and down the east coast, and raised a family. He takes on outside landscaping work with his son, who also works at a local farm, and was able to give his daughter horseback riding lessons throughout her childhood. Today, she's a mounted ranger with the Boston Parks Department. Jim sees her every week or so in the Arboretum—an intergenerational relationship with the landscape in action.

CROSBY PEACH. *THE PEACHES OF NEW YORK*, BY U.P. HENDRICK, J.B. LYON COMPANY, 1917, 202

FROM THE ROOTS

Enduring indigeneity in peach-tree proliferation

The introduction of peaches (*Prunus persica*) to North American landscapes historically has been attributed to Spanish settlements in the mid-16th century along the Atlantic Coast. A recent *Nature Communications* article presents new archaeological and ethnohistoric evidence that peaches likely spread across the eastern seaboard prior to permanent Spanish settlement, denoting the critical role Indigenous communities played in their proliferation. Using evidence from historical accounts and Accelerator Mass Spectrometry (AMS) radiocarbon dating of peach pits, researchers argue that multiple sociopolitical and ecological conditions influenced the spread of peaches to interior landscapes, including US governmental removal policies in which Indigenous peoples carried peach plants and pits during forcible relocation to reservations. Peaches retain Native cultural significance today, grown as heritage crops by members of the Muscogee (Creek) Nation.

HOLLAND-LULEWICZ, J., THOMPSON, V., THOMPSON, A.R. ET AL. THE INITIAL SPREAD OF PEACHES ACROSS EASTERN NORTH AMERICA.... NAT COMMUN 15, 8245 (2024)

“Passing knowledge on to the next generation.”
—Joy Silverstein, Arnold Arboretum member and Field Study Experiences volunteer

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arboretum.harvard.edu/support/membership

Dame Judi Stench *(Amorphophallus titanum)*

Megan Ardolino on a crowd-pleasing (and putrescent) inflorescence.

In June, the Arnold Arboretum's 12-year-old corpse plant (*Amorphophallus titanum*), christened "Dame Judi Stench" by staff, bloomed for a fleeting 48 hours, becoming the first of its kind to bloom at the Arboretum. The flower structure (inflorescence) emits a rotting-meat odor, its spathe is a muddied red, and its spadix elevates to body temperature—a mimetic trifecta of decay attracting pollinators such as carrion flies and beetles.

When not in bloom, the plant is either a dormant corm (an underground enlarged stem), storing energy for its next growth cycle, or in a foliar cycle, in which an 8-12-foot single leaf, its petiole as thick and imposing as a small tree, emerges from the corm. The plant will alternate between these cycles for about 10 years, until it stores enough energy to produce its 6-8-foot-tall inflorescence.

The corpse plant is the rarest species in the Weld Hill Greenouse, with fewer than 1,000 individuals in the wild. They are native to Sumatra, Indonesia, and though they are now legally protected, timber harvesting and palm oil production have diminished their rainforest habitats.

The Chicago Botanical Garden has led a national conservation project, sharing genetics and documenting lineages across the United States. Each corpse plant is tracked by a name rather than identification number, highlighting the importance of their individuality. Diversity is crucial; inbred plants will produce inviable seeds, thwarting conservation efforts. Judi Stench was gifted to us by the Chicago Botanic Garden in 2012. Arboretum staff chose the name Dame Judi Stench in honor of two enthusiasms: the beloved actress and the species' reputation for smelling supremely awful!

After over a decade of cultivating Judi Stench, staff, researchers, and members visited the inflorescence in droves. We shared pollen with Mitchell Park Domes in Milwaukee, WI, hoping to pollinate their 2024 expected bloom. Dame Judi is one of many plants demonstrating unique morphology in our Weld Hill Research Center teaching collection. People's drive to connect with botanical marvels is extraordinary—though certainly with her name, Dame Judi Stench was destined to capture the community as a star.

Megan Ardolino is the plant growth facilities manager at the Arnold Arboretum's Weld Hill Greenhouse.

Director William (Ned) Friedman and members share time with Dame Judi. *Photograph by Jon Hetman*

SMALL WORLD

A Current Assessment of *Metasequoia*, Specimen 0001

By Henry Lee Heinonen

After three hours of sleep, we board a morning train from Chongqing to Lichuan, a county-level city in Hubei. We had worried that traveling at the tail end of Chinese New Year could mean fighting through crowds, but our high-speed train is half-empty. As the train moves into the countryside, the scenery becomes increasingly rural, and winter becomes increasingly apparent. I take photos and short videos of farming villages wedged between snow-capped mountains. I thought I would sleep on the train, but my excitement keeps me wide awake. I am on my way to see the type tree of *Metasequoia glyptostroboides,* or dawn redwood—the first-identified specimen of

On the train to Lichuan, home to the China *Metasequoia* Botanic Garden. *Photographs courtesy of the author*

a "living fossil" once thought extinct. And I have convinced two friends to join me: Gabriele de Seta and Dino Zhang, both ethnographers who study digital media. Neither of these friends knew about *Metasequoia* a month ago, but I've done my best to tell them why it's a special tree.

The first *Metasequoia* I saw, consciously, was at the Royal Botanical Gardens in Hamilton, Ontario. My mum, a landscape architect, suggested the visit as a safe outdoor activity, as we were experiencing the first waves of COVID. We worked our way through the rock garden and some perennial beds, and then we reached the tree. My mum told me its common name, "dawn redwood," and explained that it is a "living fossil," once thought to be extinct, but then rediscovered. Immediately intrigued by the story, I spent some time looking at the tree, examining its straight, powerful looking red-brown trunk, fluted at its base and marked by knurls where thick lateral branches protruded at nearly right-angles. I crept beneath its branches to the trunk and looked up.

From that moment, I became a staunch advocate for the tree, telling friends and family about its interesting history and features. I spend some time every winter in Toronto collecting seeds from local trees planted in city parks. I've distributed some of these seeds to fellow Toronto Master Gardeners, to see if any of them have luck germinating it successfully (as for my own attempts with germination, out of hundreds of seeds I've managed to rear only a handful of saplings, now planted out of the city on a property by Lake Ontario). I've joined an ever-expanding online community of metasequoia-enthusiasts, in the "*Metasequoia* Geeks" Facebook group run by Alabama-based grower Jared Fager. In this online space, we trade germination guides, pruning tips, and of course endless photos of special specimens seen in parks and gardens. Members include arborists, scientists, landscapers, and people who just love the look of the tree.

My two friends Gabriele and Dino, being anthropologists and always up for some field research, were easily swayed by my pitch to make an informal field trip to the first specimen: the type-tree, specimen 0001. As ethnographers, I figured, we could go not only for my personal interest in the tree, but to do some preliminary research on how the tree exists as a cultural landmark or tourist attraction.

Now, as I stare out the window, I listen to a podcast about the "discovery" of the tree. I have already listened to this episode, but I want to review the details: which paleobotanist made the initial fossil discovery; which botanists made the subsequent rediscovery of living trees; and which scientists brought seeds back to the US. Hearing this story again makes me even more excited. And as we approach Lichuan City, I start seeing groves of trees that look a lot like *Metasequoia*. As it is winter, the trees, being deciduous conifers, are bare, and skeletal. Some of them are near streams, some are near houses and farms. I wonder: are these groves "wild," or planted by locals? After being initially impressed by the train's top speed of 190km/h, I now wish we would slow down so I could get a better look at them.

Metasequoia glyptostroboides was first described in fossil form by Japanese Paleobotanist Shigeru Miki (1941), who was able to distinguish the plant from both *Sequoia* and *Taxodium*, thus establishing a new genus.[1] In the next five years, through the combined efforts of Professor H. H. Hu, Wan-Chun Cheng, and foresters from China's Central Bureau of Forest Research, living populations were discovered and identified in Hubei Province.[2] Based on his 1948 expedition to Lichuan, J. Linsley Gressit (1953) described the tree as being in a state of "semicultivation," as locals moved volunteer seedlings to their farmlands. Transplanted trees would be used to predict the success of rice harvests, as good cone production on the trees was believed to correlate with rice production nearby. In 1947, seeds were sent to the Arnold Arboretum. The story of the Arnold and the story of *Metasequoia* are now forever interlinked, as it served as the first landing point for the tree outside of China. This relationship is memorialized in the Arboretum's logo: an illustration of a dawn redwood. For further reading on the history of this relationship (as well as the tree itself), the best source is the Arboretum's 1998-99 special issue of *Arnoldia, Metasequoia after Fifty Years,* which compiles selected papers from the discoverers of the tree, and modern botanical and paleo-botanical assessments of the tree. It also includes a republication of the announcement of the tree's arrival at Arnold Arboretum by E. D. Merrill, director of the Arboretum from 1935–1936.[3] In this announcement, originally published in 1948, Merrill outlines the Arnold Arboretum's role in the tree's rediscovery and distribution. Early in the paper, Merrill makes sure to mention that Dr. H. H. Hu was himself trained at the Arboretum, and that Professor Cheng "writes that without the modest grant made by the Arnold Arboretum, it would have been impossible for his

Specimen 0001 in Chinese Metasequoia Botanical Garden, Moudou, Hubei Province.

Lichuan and the *Metasequoia* Botanical Garden are situated in western Hubei province in the heart of China. *Map by Kyle Port*[4]

representative to make the trip" to collect samples from the tree. He writes "the Arnold Arboretum has made an important contribution, working through its Chinese associates, in thus being involved in an attempt to preserve a remarkable conifer, and a species that in its native habitat is apparently not far from the verge of extinction."[5]

Since those early years, the continued survival of the dawn redwood in nature has been a focus of continuing scholarship. The tree remains endangered in the wild (IUCN); the native range of the tree remains limited, and is threatened by climate change.[6] Natural regeneration is exceedingly rare,[7] and though the tree has become numerous, its genetic variation in cultivated populations is lower than that of its wild populations.[8] As the tree has become both a focal point for conservation attention and national mythos, a park, the Chinese Metasequoia Botanical Garden, has been created in Moudou in Lichuan, Hubei province, to showcase the type-tree first identified by Hu and Cheng.

After two hours on the train, we arrive in Lichuan City. Outside the train station, we find a large public map of the surrounding area. The featured tourist attractions seem to be scenic mountain views and vast caves, which are numerous in this region. Block text to the side of the map reads "Cool Lichuan" in English, proclaiming it "the famous cultural city in Western China," "the most beautiful China eco-tourism destination city," and a "cool city in China." A local man in a black coat is hanging out by the sign and points us to the exact location of the tree. His price to drive us to the tree and other local attractions is 300RMB for the day, which we accept. We follow the man to his car, a black Chevy hatchback, and settle in for a 40-minute drive. He drives very quickly and swerves around several cars in maneuvers I would never attempt. Dino remarks on the empty buildings around Lichuan City. Many apartments and office buildings are either under construction, completed but empty, or closed. We drive through mountain tunnels, each filled with fog and exhaust fumes. There seems to be no ventilation in the tunnels. After passing through two or three long tunnels, we arrive at the small village of Moudou (formerly known as Modaoxi or Modaoqi, which is how it is named in online maps), and cruise along its main street. The village reminds me of Canadian small towns in its layout of two-story businesses and homes all shoulder-to-shoulder along the road.

The road widens, and our driver stops, and tells us we've arrived, and that he will wait in the car. I climb out of the hatchback onto the road, feeling a bit wobbly on my feet from lack of sleep. Facing us at the entrance of the park is a line of trees, all metasequoia, about ten meters tall, and a series of small bridges over a stream. And there, over the bridge, and past the smaller trees, is Specimen 0001. My fatigue vanishes, replaced by a surge of adrenaline. I am loopy with joy. I turn to my friends, who I'd recruited to come on this long, winding journey. They seem happy and curious, though perhaps not as excited as I am. Our phones are out, and we snap pictures and take videos. I take selfies with Specimen 0001. I stare in wonder at the tree and remark on its various features, the classic lateral branching, but also some peculiar, curved branches, which I've not seen on other dawn redwoods. Specimen 0001 is adorned with Chinese New Year decor, and appears to have candles and incense that was burnt near its base. Later, I spot tangerines by the base of the tree, left as offerings. These fruits symbolize wealth and abundance during the Chinese New Year.

I ask Gabriele to take a photo of me with what appears to be the *Metasequoia* Biodiversity Park Official Mascot. The character is a little humanoid, of ambiguous gender, with a big round head and white gloves. On its head it sports the unmistakable stem of *Metasequoia glyptostroboides:* oppositely arranged leaflets with rounded tips. We see a green version of the humanoid, and an orange version. Dino theorizes that they are a couple, one male, and one female. I theorize that the green mascot represents the leaflets in spring and summer, and the red mascot represents the leaflets in autumn, as they dry on the tree. We later encounter a yellow version of the mascot, however, which undercuts our dualistic theories. I later discovered much more about the mascot's identity, as I report in a later section of this paper.

The type-tree, Specimen 0001, originally discovered in the 1940s, is now the site of a park, about 400 square meters in size (enough space for an hour of walking around at a leisurely pace). A park was originally proposed in the 1940s by a Kuomintang government committee, but was canceled due to the civil war.[9] The current park, 中国水杉植物园, or Chinese Metasequoia Botanical Garden, began its construction in the year 2000, with a cost of approximately 5.1 million yuan (then 614,500 U.S. dollars).[10] The initial construction forced the displacement of "some 20 households."[11] The shrine that once existed

Henry Lee Heinonen posing with a humanoid *Metasequoia* mascot.

right by the base of Specimen 0001 (visible in photos from early expeditions) was removed by the 1980 Sino-American Botanical Expedition.[12] In 1980, the tree was "now surrounded by rice paddies and [a] small, ditched stream."[13] By the time of the park's completion, the rice paddies were no more. Tourist photos from the last two decades, available online, show that the current artificial pond with fountains, in 2011, was a natural pond where ducks swam and people went fishing.

Specimen 0001 has undergone some changes, too. Within the past ten years, a boardwalk surrounding the tree was removed. The current enclosure is a wooden fence, the perimeter of which, judging from photos, is at least double the distance from the tree compared with the previous fencing. From a photo, I can see that at the time of the 1980 Sino-American Botanical Expedition, there was text in Chinese painted directly on the tree trunk, reading "Lichuan County Tree Number One."[14] Later, the text was replaced with a simple white sign reading "0001 Metasequoia type specimen tree." Sometime in the past eight years, the white sign has been replaced with a brown sign, which blends into the natural colour of the bark but contains the same text. And

The *Metasequoia* type tree in a drawing given to the Archives of the Arnold Arboretum by H. H. Hu, showing the shrine that once stood alongside the tree.

sometime in the last decade, a new blue sign was affixed to its trunk, on the other side from the brown sign. The blue sign displays a QR code directing to a website listing Specimen 0001's height, age, and other statistics. In almost every photo of Specimen 0001 there are red ribbons strung up on the tree by local worshippers, the kind used to mark a hong bao tree (a wishing tree, or money tree, where during Chinese New Year, red ribbons, representing wishes for good fortune are placed on the branches).[15] I imagine the tree has received ribbons and offerings for a very long time. Now, there is a metal post near the entrance of the park with CCTV cameras pointed at the tree. Are worshippers who step over the short wooden fence surveilled? And by whom?

By mindlessly posting photos of the tree on social media on the day of my visit, I've added to the digital repository through which changes to the park and Specimen 0001 can be tracked. Now, when I do a Google image search for "metasequoia specimen 0001," my own photo is the top result. The newest addition to the digital archive shows the type tree and its immediate surroundings as a subject of veneration and care, embraced by a large red sash, adorned with red lanterns. Out of view: a QR code, and CCTV cameras. The tree, which for hundreds of years could only be seen in person, is now digitally archived, rendered visible from any smartphone in the world. For a fossil, *Metasequoia* has changed quite a bit in the past century. Specimen 0001, first an object of worship, became an object of scientific inquiry, an object of surveillance, a tourist attraction, a mascot, and a national symbol. This is clearly a very adaptable tree. We come across a large flat area with a planting of maybe 40 trees, all metasequoia, which I estimate to be in their teens, with ornamental underplantings of sedge and grasses. Again, we encounter our mascot friend beaming at us, not only in 3D statue-form, but also on signs promoting exercise. There are indeed several local aunties and grannies using the park for exercise, doing multiple rounds of the park in a small group while chatting. I see no other foreigners. There are three statues in this area of the park, busts of middle-aged men. They each have a plaque, but the plaques are covered in snow. I try to brush it off with my ungloved hand, but the writing underneath is worn and hard to read. I am left to assume that at least one of the figures (one of the two wearing glasses) is Professor Hu. The others are likely Professor Hsieh and Professor Cheng. Across from the Professors there is a fenced-off section, with a collapsed, rusty steel structure inside—perhaps this had a tent over-top of it at some point. A sign explains that this is a university research area, with teams working there since 2017. There are metasequoia seedlings planted in other fenced off research areas nearby. These sections contain thousands of metasequoia, some tagged showing planting dates around 2018.

Back by the entrance, we again stop by Specimen 0001. We watch a woman who has hopped the fence around the tree and is kneeling by its base. She lights candles and incense. When she has finished, she returns to the path and to her husband, who has been waiting for her. I try to start up a conversation in my very basic Mandarin. I tell them, awkwardly, that I "love" the tree. The woman does not want to speak with us and keeps walking, but her husband stops briefly. He is smoking a pipe with a towering pile of tobacco in it. I ask, again awkwardly, if they love the tree, too (my Mandarin is very limited). He does not hesitate and responds loudly and with a smile: "we love it!" He then tells us that the old tree "is an ancient thing, and ancient things protect us, so we make offerings to it." His wife eyes us warily

(Left) Tagged trees in a fenced-off area of the park; (right) a statue of Hsen Hsu Hu with his trademark round spectacles.

and beckons him from down the path, and he leaves us. The husband and wife seemed much more nervous about talking to us than being surveilled by the CCTV cameras.

Seeing the type tree adorned with lanterns and a red sash, and seeing locals make offerings, I am left to wonder what its importance is, culturally or spiritually: what do locals think about the tree? Here, the literature is lacking. Hong (1999) notes that metasequoia are worshiped to "bring the family good luck (nowadays translated into prosperity) and bless their children with healthy bodies and bright minds",[16] and other scholars note a shrine built at the base of Specimen 0001.[17] But these are minor observations, and after eight decades there exists no in-depth research into the cultural importance of the dawn redwood. My own short interaction with locals worshipping the tree left me with more questions than it answered: are other large dawn redwoods venerated similarly? Do offerings change according to seasonality? The woman giving offerings had to hop over a fence to get to the tree—is local worship at odds with the park's mandate or operations? What is the story of the removal of the shrine between the 1950s and 1980? Long-term ethnographic research would be necessary to properly understand local beliefs about metasequoia.

If we are not currently able to analyze *Metasequoia* as an entity in folk religion specifically, we can still analyze the tree as a local and national symbol more generally. As Yuheng Zhang argues, nationally, the tree has been useful for the Chinese state and the creation of its mythology.[18] Its ancient past is used as a parallel and augmentation of China's own long cultural history, and its discovery by a team of Chinese rather than foreign botanists is a point of national pride.[19] The park, notably, is 中国水杉植物园, Chinese Metasequoia Botanical Garden. 中国水杉, Zhongguo Shuishan, or Chinese metasequoia, is a common name used for *Metasequoia*, which contains the adjective "Chinese" "...only to emphasize its perceived 'Chineseness' and the link to the Chinese national identity," as "the tree exists only in China, and in the Chinese language the name *shuishan* is reserved for this genus alone."[20] Busts of the statues of Chinese scientists are featured in the park, with no mention of Shigeru Miki or any American scientists (at least in the English plaques). The international

Chinese Metasequoia Botanical Garden is a continuation of the ongoing nation-building process facilitated by the tree.

and collaborative aspects of *Metasequoia's* early rediscovery (as well as its prehistoric global reach as a species) are occluded in favor of a more nationalist and triumphalist narrative.

Back in the park, the three statues and emphasis on the Chinese actors and aspects of the species' rediscovery could support Zhang's (2019) observation that the rediscovery narrative was used to prove the "development of science in China and highlight one big step towards modernity."[21] Zhang continues, "Chinese citizens, by associating with this iconic species, gain a psycho-emotional experience, a new appreciation of time and space, and thus the assurance of China's place in the world."[22] The discovery of this tree is indeed an important moment for Chinese science and China as a modern nation. It was primarily discovered by Chinese, rather than Western scientists. These Chinese scientists trained as modern botanists in modern institutions, and were properly credited with their discovery of the metasequoia.[23] Nonetheless, Chinese Metasequoia Botanical Garden is a continuation of the ongoing nation-building process facilitated by the tree, as described by Zhang. The large, engraved stone by Specimen 0001 gives a brief overview of its discovery, natural history, and dimensions. It also makes mention of Deng Xiaoping, who made mention of the tree as "that tree on the edge of the Yangtze River," tying the site into a larger national history. Deng Xiaoping made use of the tree as a distinctly Chinese symbol during his leadership, planting a metasequoia in Nepal with Prime Minister Kirti Nidhi Bista during a historic 1978 visit.[24] Deng and Zhou Enlai are also reported to have "presented metasequoia seeds as precious gifts to other countries."[25]

There is at least one anecdotal account online which indicates a hybridity of local folk understandings of the tree and its national symbolism. An anonymous writer recounts their 2004 encounter with a local elderly man of Moudou who claims that the tree lost a branch when Mao Zedong died, and another large branch fell when Deng Xiaoping died. These events, suggests the writer, add to the local understanding of it as a "sacred" tree.[26] Interestingly, the nationalist *Metasequoia* narrative coalesces with some non-Chinese conservationist plans for the protection of the tree. Gaytha A. Langlois, in "A Conservation Plan for *Metasequoia* in China," writes that the species "needs to be marketed as a Chinese national treasure."[27] The tree is "an intrinsic part of China's

杉杉 with their siblings, all Lichuan agricultural products: a potato, red tea, a leafy-green water vegetable, and a root vegetable. From a promotional Lichuan video showing 杉杉 dancing by Specimen 0001 with a group of tourists, featuring the Ode to the Motherland, with 杉杉 杉杉 encouraging locals to exercise by walking the park's long paths, extolling the virtues of exercise in fighting illness.

natural heritage," Langlois argues, and "thus important to all citizens in the nation."[28] Langlois further imagines villagers as potential "eco-guides" who will provide tourists with "local lore" and "natural history observations."[29] Their participation in such a program, Langlois predicts, could "develop a sense of identity with the protected *M. glyptostroboides* forests"[30] amongst local citizens.

This sense of local identity in relation to the tree does seem to exist, at least on an official level. Hubei's provincial capital, Wuhan, has selected the metasequoia as the "City Tree."[31] More locally, the symbolic reach of *Metasequoia* has extended to the entire county of Lichuan: consider the friendly metasequoia-mascot I encountered by Specimen 0001. I now know that the metasequoia-mascot is named "杉 杉" (*shān shān*), derived from the Chinese word for *Metasequoia*, 水杉 (*shuǐshān*, translated literally to "water fir"). The mascot, created by Pan Wenjun in 2016, appears not only in the park, but in other promotional Lichuan County material: signs in the urban areas, and even in a 2018 campaign alongside other mascots showcasing Lichuan's global exports. According to China Lichuan Net News, the "cute and friendly image" of 杉杉 is meant to reflect the "hospitality, openness and tolerance of the people of Lichuan."[32] In one article promoting tourism to Lichuan, 杉杉 is described perfectly, in the website's English translation, as the "*Metasequoia* Elf." 杉杉 is a locally created entity who functions as an advocate of Lichuan and wedges itself neatly into the Chinese *Metasequoia* Botanical Garden, smiling and waving at tourists. While the park features the nationally ubiquitous Core Socialist Values on stone engravings, 杉杉 provides a much softer official messaging. In one sign, 杉杉 proclaims that exercise can promote good health and reduce illness. In other signs throughout the paths, 杉杉 beams over a distance marker telling joggers and walkers how many meters they've travelled so far. Outside of the park, 杉杉 can be found in inflatable form, travelling to nearby cities like Wuhan to promote Lichuan as a tourist destination.[33] 杉杉 is a gentle and cute authority, operating similarly to Japanese *kawaii* aesthetics used by organizations to "endear themselves to stakeholders; to make their message content simpler and engaging; and in the case of impersonal or authority-wielding institutions, to soften their image."[34] This type of Japanese-inspired mascot is now popular in China (see the five 2008 Olympic mascots, four of which represented

cute anthropomorphic versions of animals found in China). I found myself endeared almost immediately—my first reaction upon meeting 杉杉 was to take selfies with it. 杉杉 is also marketable: I found myself wishing I could take some 杉杉 souvenir home with me, but there was no gift shop at the park. I have since found photo evidence online that 杉杉-branded merchandise does exist. In 2020, Lichuan created promotional luggage tags, one featuring 杉杉, and another featuring a cartoon of a character in traditional clothing of the Tujia. Tujia are an ethnic minority in China, numbering around 8 million people, mostly residing in Hunan and Hubei provinces."[35] Tujia as a language has become endangered over time, with newer generations speaking mostly Mandarin.[36] Now, Tujian cultural motifs have been thoroughly integrated into local tourism, with Tujia dance and traditional clothing featured heavily in promotional videos. In a romanticized narrative, the Tujia people, "living in harmony with nature,"[37] are imagined to have protected the metasequoia. Indeed, a traditional origin story of the Tujia people is that they are descendants of a pair of siblings who clung onto a great metasequoia tree for survival during a storm.[38] This connection between the Tujia people and the species is a convenient one for Lichuan tourism, as it combines two "attractions" into one package that might capture the imagination of tourists (see photo of promotional luggage tags).

Digitally, 杉杉 has been a promotional figure for Lichuan. In one Lichuan promotional video, 杉杉, (appropriate, as Gabriele remarked, given the tree's monoecious nature), speaks from a stage to a crowd of ecstatic global consumers about Lichuan's booming export economy. 杉杉 translates their Potato-sibling's Chinese speech into English for the crowd. 杉杉 encourages the other characters to go out into the world where they will be greeted as high-quality products. As the tree's official anthropomorphic form and the most iconic natural symbol of Lichuan, 杉杉 acts as the ambassador and coordinator for global trade. In online media as in the park, 杉杉 is similarly able to operate as a local ambassador alongside more nationalist messaging A video posted by Cultural Tourism Lichuan on *ixigua,* for "Praise to the Party and Welcome the State Day," shows Cultural Tourism workers in a variety of Lichuan tourist destinations (excluding the *Metasequoia* Garden, unfortunately), wearing red shirts, wave Chinese flags, and sing the patriotic song "Ode to the Motherland." And on their red shirts, over their hearts, is 杉杉.

The Enduring Myth of *Metasequoia*

Zhang's (2019) aforementioned argument for the significance of the tree in Chinese national identity is convincing, but I am not a Chinese citizen, and nor are many of the other tourists who visit Specimen 0001. The story of *Metasequoia* is universally accessible, as it is not one story. For the Arnold Arboretum the tree represents institutional success—this was the original destination of the first seed shipment out of China. Some of the first trees grown outside of China now reside at the Arboretum, now with massive and fluted trunks. It is also, as the Arboretum's associate director of external relations and communications Jon Hetman, says, "a survivor."[39] Even groups unconnected to the original story of the tree's discovery have adopted the dawn redwood as a symbol—one organization plants *Metasequoia* at former Holocaust sites in Ukraine.[40] Their 2018 newsletter states that "[t]he story of survival and rebirth of metasequoias is incredible, paralleling the resilience of Jewish people and the rebirth of the Jewish life all over the world."[41] The dawn redwood is an underdog, endangered but making a global comeback, and its struggle makes for a compelling narrative.

In the 1940s, worship of Specimen 0001 took place at a physical shrine at its base. In 2024, worship takes place underneath a QR code, under the gaze of nearby CCTV cameras. Older expeditions to the tree were risky affairs, with local bandits hiding in the dark, and destinations unmarked on paper maps.[42] In our expedition, a local driver was waiting by the train station, ready to take another hapless group of tourists to all the regular Lichuan hotspots for cash. Popular Western speculation and discourse around the tree used to take place in newspaper articles. Now it takes place in specialist Facebook groups. As the world transforms, so too does the ancient tree.

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HENRY LEE HEINONEN *is a landscaper, ethnographer, and musician living in Toronto. He is currently completing his horticultural training as a member of Toronto Master Gardeners.*

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Unexpected Resilience

By Kim Shearer

"Where are you from?" is a question that I have been asked throughout my life for as long as I can remember. And when my response did not suffice, as it often did not, the follow up question would be, "But where are you really from?" Now, as director and curator of the living collections at The Morton Arboretum, I find myself asking the same questions of trees—where are you from, where are you really from, what is your provenance?

In my role at the arboretum, one of my responsibilities is to determine how best to develop the collections to meet the needs of a wide range of stakeholders: from the programming needs of the education department to those of internal research scientists; from the needs of plant conservation to new plant development; from the needs of the surrounding local community of Chicagoland to those of cities and communities beyond our borders. This goal becomes more complicated when determining how to develop a resilient collection for a future of challenges posed by climate change, including predicting the potential needs of researchers in twenty to fifty years. The question of provenance is a thread that ties all of those needs together. "Where are you from?" is a question that can drive education programming, interpretation, and research. The acquisition of provenance diversity supports conservation efforts and ensures genetic diversity for the future while providing subjects for ongoing research and development.

When we ask this question of each other—*where are you from?*—the traditional response includes a combination of where one was born and raised, the two places often being one and the same. My personal response frequently includes Massachusetts, Georgia, West Germany, South Korea, North Carolina, Hawaii, Oregon, Illinois, Chicago as where I have lived; Fayetteville, where I graduated high school; Raleigh, where I spent much of my adult life—a list of the places I have lived and their relevance in my timeline relative to age and maturity, with the least significant place being the one where I was born, Louisiana. And the most significant thing that connects all of those places: they represent a diversity of forests and gardens.

In my experience, when we ask this question of trees in the horticulture and gardening communities, it's often with the subtext of, is this species native? Is this species potentially invasive? If I type the phrase "plant provenance" in a web browser search bar, the first hits are blog

Opposite: Cedar elm, *Ulmus crassifolia,* in fruit at the Morton Arboretum. *All photographs courtesy of the author*

posts from native plant nurseries and native plant enthusiast societies based in a variety of regions around the globe. Many of the conversations revolve around the benefits of local provenance with some caveats regarding the nature of developed landscapes. Similarly, when I am asked, "Where are you from" and my rather long-winded response does not suffice, I know that the question is not about where I was born and raised, but rather where I am native.

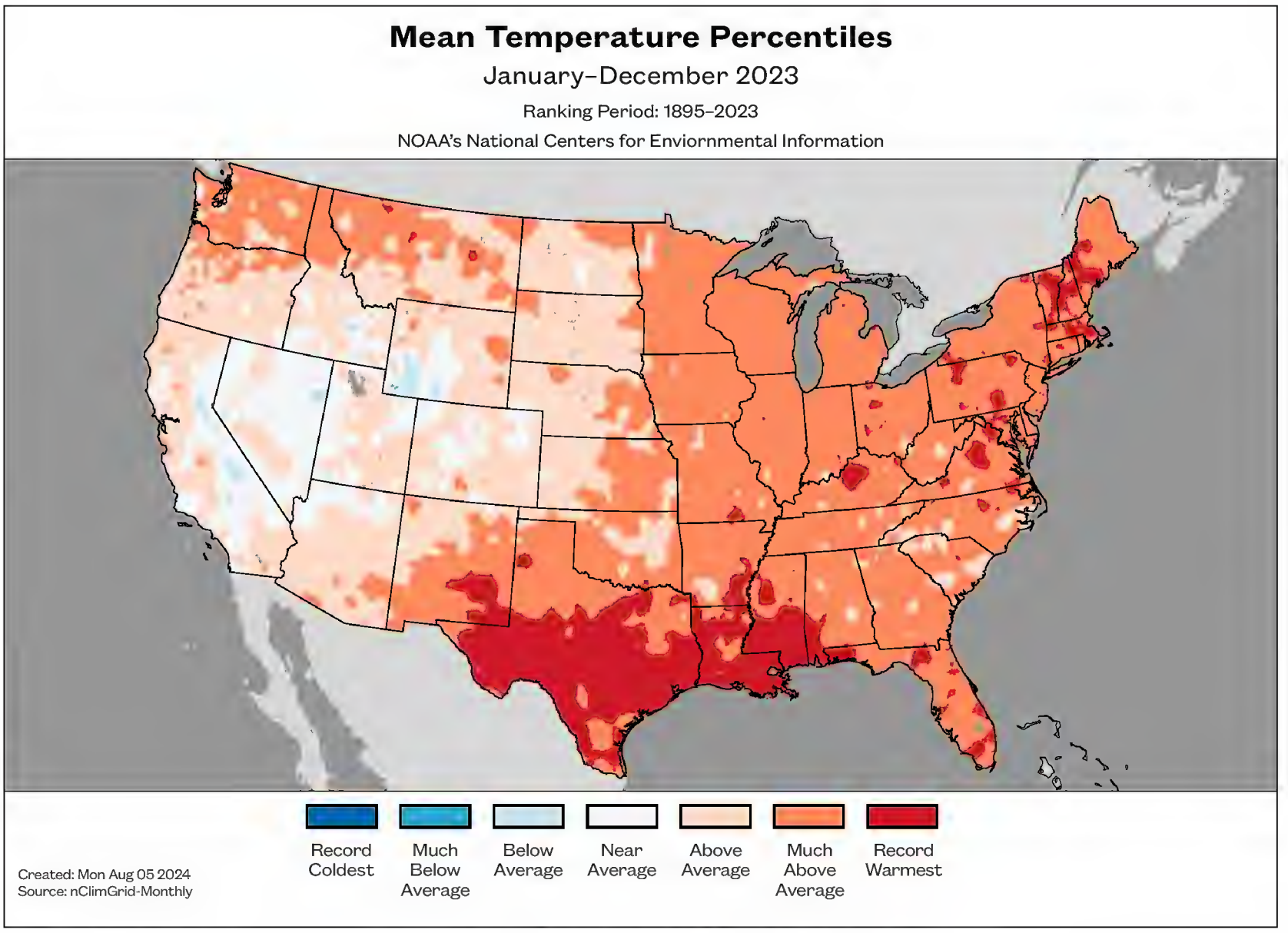
I am not disputing the benefits or value of preserving ecological communities established through a long evolutionary history in collaboration with indigenous humans. However, as curator of a world-renowned centenarian collection at a 1700-plus-acre arboretum in the developed landscape of the west suburbs of Chicagoland, I am seeking answers for a different purpose. It is our mission to collect plants from around the world and grow them for the purpose of evaluation, research, and conservation. I need to know, which trees and shrubs are going to survive here in 30 years? How about 50 years? Which plants have demonstrated some climatic plasticity or adaptability? Which plants can I forecast to be resilient? Because, you see, resilience and adaptability are necessary in the face of an uncertain future that we know will be characterized by what we humans would consider climatic chaos.

As someone who has experienced the prying question of provenance, I find it best to not make assumptions based on where one is from. In fact, I find it more useful to challenge ourselves and our thinking by setting those assumptions aside and being more curious about what one could be capable of outside the parameters of native-ness. As Davis et al. (2011) stated in their note on species origins, "[n]ativeness is not a sign of evolutionary fitness or of a species having positive effects." In fact, one that is native can also be detrimental given the appropriate conditions and experience. Just as one that is not native can have a positive impact on their environment or community given the right timing and provided the opportunity to do so. The southern pine beetle (*Dendroctonus frontalis*) is a prime example of the capacity a native insect has to destroy native pines and their associated ecosystems (Tchakerian and Coulson, 2011).

The world is getting warmer every year, seasonality is shifting, precipitation patterns are changing, and in some cases weather may be more difficult to predict (Sheshradi et al. 2021; Le et al. 2023). In the 2023 annual summary report of the US climate (NOAA, 2024), it was noted that the mean temperatures were both consistently and significantly higher than the average temperature of the twentieth century with few exceptions. With these changes and uncertainties facing us, we do know that we will need more heat-tolerant plants that are also cold hardy, exhibit tolerance to increasing variation in precipitation patterns, and carry the genetic resources to address potential increases in disease and insect pest pressure due to a warming climate.

Where does one even begin? How do we answer the question of resilience through our living collections? At The Morton Arboretum alone, we have a collection of mostly woody living plants that includes approximately 25,000 unique specimens representing nearly 5,000 taxa and more than 2,000 species; and that does not even include every single plant in our tree research plots, natural plantings, or display gardens. Our living collections are represented by taxonomic collections that can be used for comparison studies, geographic collections that showcase regional diversity, and special collections developed around themes such as trees of conservation concern. We have six taxonomic collections that have been accredited by the Plant Collections Network of the American Public Gardens Association. These include *Acer, Magnolia, Malus, Quercus, Tilia,* and *Ulmus;* and our *Magnolia* and *Quercus* collections are part of the Botanic Gardens Conservation International (BGCI) Metacollections project that facilitates collaboration in collections development for target taxa groups.

When I first came to Morton eight years ago, I was recruited as the new tree and shrub breeder for the long-valued legacy breeding program dedicated to elm improvement initiated by Dr. George Ware in the early 1970s. As a breeding student, I had learned the methods and techniques of traditional and modern breeding from something seemingly as simple as how to conduct a controlled cross to methods of DNA extraction and marker development—both of which also turn out to be relatively simple, while also being elegantly complex. I learned how to identify the smallest differences amongst any given collection of plants including genome size, ploidy, flowering phenology, morphology, and fertility. The taxa in my thesis included *Acer, Galtonia candidans,* and *Penstemon*. Yet, the breadth of taxa that we worked with in the research program is much vaster; and the skills acquired by a plant breeding student are not limited to any particular taxa. The theme that tied my thesis



In most of the US, mean temperatures in 2023 were higher than the twentieth-century average; data suggest a profusion of microclimates. *Map by the author; data from Vose et al. 2014*

together was evaluating and inducing genetic diversity amongst a given taxon to be used as germplasm for developing new plants intended for the developed landscape. I learned how to quickly and efficiently become an expert on any group of plants in a relatively short amount of time.

This experience would prepare me for what would come next in my professional career, as I began to study elms in books, on paper, and in the living collections. I really did not yet know much beyond what most generalist horticulturists know about elms: that they usually have oblique leaf bases; that their fruits are single winged samaras; that they flower in the late winter and early spring distributing copious amounts of seed throughout city streets and parks. Wind-pollinated, they are the source of my misery near winter's end. Many of our native American elms (*Ulmus americana*) were devastated by Dutch elm disease (DED, *Ophiostoma ulmi* or *O. novi-ulmi*) due to our propensity for global trade coupled with our human desire to create aesthetic uniformity in our streets and parks that echoed the natural beauty of floodplain forests.

In both the library and the field, my knowledge grew. I learned to select trees with clean or undamaged foliage in the spring and early summer, because that was an indicator that they were not a preferred feeding source for the two Eurasian elm-feeding species, flea weevil (*Orchestes steppensis*) and elm leaf beetle (*Xanthogaleruca luteola*). An introduced species, elm flea weevil causes foliar damage primarily on Asian elms and their hybrids at both the larval and adult stages. Elm leaf beetles cause significant foliar damage on new leaves as they are emerging, sometimes resulting in completely skeletonized leaves that stress trees and make them more appealing to the elm bark beetles that are the vector for DED (*Hylurgopinus rufipes, Scolytus multistriatus, S. schevyrewi*) (TMA, 2024a, b; USDA-USFS, 2011).

And so, in my first spring of 2017, I took a walk through our Nationally Accredited elm collection and opened my eyes wide to seek out signs of infestation. I remember that the leaves were wet from a spring rain. Many trees had developing seeds on them. And most trees were not particularly engaging to my eyes. Then

The compact habit of the cedar elm among neighboring elms at the Morton, with new-plant development program volunteer Donna Ucherek showing the scale of the trees.

there it was. A tree that many nursery folks since have ogled due to its uniform shape, which resembles a sheared fir destined to be draped in the festive decorations of the winter solstice. It had very small leaves with the scabrous texture of a cat's tongue, a low-branching crown shaped like an isosceles triangle, no fruit developing, and best of all—the cleanest, most unblemished leaves, free of insect damage.

What was this tree? It was unlike any elm that I had yet come across with its tight branching and essentially perfect unpruned form. The leaves were smaller than those of most other elms, on average 2.5-5 cm long and 1.3-2 cm wide, tightly attached to the stem with a petiole ~1.5 mm long, and with somewhat oblique leaf bases and an obtuse apex. The bark was somewhat corky like *U. alata,* though not on the new growth, and it was densely branched with short internodes and no signs of cold damage. I stepped under its branches that were shockingly lower than my height at just 5'2". The label read, "Cedar elm / *Ulmus crassifolia* / 385-68*1 sd." Now I knew a common name, the species, and also that we had received it as seed in 1968.

I had come across this species name over the winter of 2016-2017 as I was poring over the archived papers of George Ware's breeding program and its introductions of Asian elm (*Ulmus davidiana*). Coincidentally, the original tree, or ortet, which we now know as *U. davidiana* 'Morton' Accolade®, originally was received and accessioned into our living collections as *U. crassifolia* (Ware, 1980). Ware had enough knowledge and experience with southern species of elms when he came across the ortet to know that it in no way resembled *U. crassifolia*. In fact, he had even brought a packet of wild-collected *U. crassifolia* seed to the arboretum in 1968 when he was recruited as the first Director of Research.

And here I was standing before a tree grown from that packet of seed that had once nestled in Ware's hands. No wonder he had his doubts! In fact, it was clear that the leaves of *U. crassifolia* were not preferred by any insects, because the leaves were likely too thick and scabrous for chewing, having accumulated the natural plant defense silicon to cause digestive discomfort in feeding insects (Leroy et al., 2019.) I began to do some research, and asked this plant, "Where are you from?"

Ulmus crassifolia is sparsely distributed across just seven southern states in the U.S.: Oklahoma, Arkansas, Tennessee, Texas, Louisiana, Mississippi,

Ulmus crassifolia shows distinctive corky bark on densely-branching old wood with short internodes.

and Florida. It is also reported in the Mexican states of Coahuila, Nuevo León, and Tamaulipas (Villaseñor, 2016). Reported cold USDA Plant Hardiness Zones (PHZ) for the species vary depending upon the source and publication. Many garden, nursery, and horticultural sites rely on the same references for cold adaptability. The coldest tolerance that has been reported for cedar elm is Zone 6a (Gilman and Watson, 2015) with an average annual minimum temperature of -5 to -10 °F. At The Morton Arboretum, the PHZ was considered 5b until the newly published 2023 PHZ map identified a mix of zones 5b and 6a depending on microclimate. The specimen with plant ID 385-68*1 was planted in the 1970s in a fully exposed site adjacent to the Dupage River. Since the tree has been planted, it has experienced multiple flooding events and polar vortexes, with a record low of -23°F reported in 2019 more typically experienced in PHZ 4b.

Native habitats of this elm include riparian areas with moist, limestone soils, and dry limestone hills, making this species suitable for built landscapes where the root-zone pH is known to be alkaline due to the composition and chemical properties of concrete and other construction materials. The species is also known to grow in both the deep, rich soils of the Mississippi Delta and dense, poorly draining clay soils in central Texas, indicating it is broadly adaptable although somewhat limited in geographic distribution. While it is not distributed very far north, it is associated with many species that are known to have broader geographic distributions and cold hardiness into PHZ 5, including *Carya illinoinensis, Populus deltoides, Acer rubrum, Gleditsia aquatica, G. triacanthos, Diospyros virginiana, Acer negundo,* and *Taxodium distichum* (Stransky and Bierschenk, 1990). In addition to being broadly adaptable, cedar elm offers some ecological services that are not limited to local adaptations. Seeds are eaten by birds, vegetative buds are eaten by squirrels, pollen is available in the early fall for insect foragers, and the tree is a larval host for the broadly distributed question mark and mourning cloak butterflies (*Polygonia interrogationis* and *Nymphalis antiopa,* respectively) (LBJ, 2024).

Taxonomically, one would suspect that cedar elm aligns with its summer-fall flowering Asian cousin the lacebark elm (*U. parvifolia*) as a member of Section Microptelea due to its nature of flowering in the late summer to early fall (Schneider and Wilson, 1917). However, in 2021 Whittemore et al. found that *U. crassifolia* was more genetically akin to species in

Inflorescences and developing fruit on the fall-flowering September elm (*Ulmus serotina*).

Section Chaetoptelea, which includes the three North American species *U. alata, U. serotina,* and *U. thomasii* and the Asian species *U. elongata*. *Ulmus serotina,* or September elm, is the third fall-flowering species of the genus and the most closely related to *U. crassifolia*. With a shared reproductive phenology and genetics, it is no surprise that these two have been reported to naturally hybridize. According to Flora of North America, the two species hybridize when sympatric forming the informally named *U.× arkansana*. Based on a hybridization study completed by Santamour (1972), *U. serotina* is also sexually compatible with *U. parvifolia*.

The three fall-flowering elm species can easily be distinguished from the remainder of the genus simply by observing the timing of flowering and fruiting. To distinguish the three species from each other is quite simple, too. They each have distinct foliar and bark traits. Where *U. crassifolia* has brown bark with shallow fissures and plates and leaves that are scabrous and dark green adaxially, *U. serotina* has light brown to reddish bark with shallow fissures and leaves that are both glabrous and yellow-green adaxially, and *U. parvifolia* has the characteristic exfoliating lacebark exhibiting a range of colors from olive green to orange, and leaves that are glabrous, dark green, and glossy adaxially (Sherman-Broyles, 2020).

According to our records, the seed that Ware donated in 1968 was collected in Seguin, Texas, a provenance that might seem odd for a plant that has tolerated a half-century in a PHZ 5 location. Seguin's PHZ at the time of seed collection was 9a. Today, Seguin is categorized as a chilling 8b, likely due to the new normal of experiencing extreme weather events that include abnormally cold winters in southern parts of North America; or perhaps this is due to having more robust data in the development of USDA Hardiness zone maps. All the same, it is a wonder that Ware even considered bringing seed of the species from such a southern latitude, considering the provenance assumptions that we often rely upon. However, many plant species tolerate cold temperatures that are far colder than the PHZ of their current ranges. *Franklinia alatamaha,* now extinct in the wild, was once native to a part of Geogia with a PHZ of 8 or 9, and yet trees have been successfully cultivated in PHZ 5.

Currently, there are two specimens of cedar elm in the elm collection. The second individual was accessioned in 1986 (14-86*3) and was wild collected

Diversity, resilience, and horticultural interest meet in the contrasting bark of (left to right) *Ulmus crassifolia, U. parvifolia,* and *U. serotina.*

in McCurtain, Oklahoma (PHZ 7b). We have had other accessions of the species in the form of seeds and plants. They have all been discarded for various reasons including poor germination of seeds, loss of central leader for a specimen, and one individual due to DED infection. The specimen that succumbed to DED was another one of the seedlings from the 1986 accession (14-86*2). It is possible that researchers grew more specimens for DED evaluation, however those records are either lost to time or have yet to be discovered.

Many publications and webpages note that there is the potential for DED susceptibility in the cedar elm. However, there seems to be very little evidence in the literature that this is the case. There is one confirmed case of DED in *U. crassifolia* reported by the Texas Plant Disease Diagnostic Library in College Station, TX in 2005 (Appel, 2009). While this incident was confirmed, Appel also notes that there is likely intraspecific genetic variability, conferring intermediate susceptibility to DED in the cedar elm. Perhaps there is a need to evaluate this species more for both DED tolerance and cold hardiness based on the potential genetic variability for both traits. Possibly due to assumptions regarding both DED tolerance and cold hardiness, the species has not been sufficiently evaluated in our collection.

To me, it's clear that there must be some intraspecific genetic diversity. And based on what I have observed and learned about this cedar elm, I now have more questions about this species, and the rest of our collections, too. First, how many other gardens have tried cedar elm? How often? What is the level of genetic diversity in the wild? What about the genetic diversity of those planted on the streets of southern states? How many other species are out there on our grounds with unexpected cold hardiness? What about heat or humidity tolerance? Where did they come from? How many outliers are out there? Stay tuned, because I do intend to answer those questions.

We expect climate change will bring us weather patterns characterized by extremes in both temperature and precipitation. We are already witnessing this in real time. In a 2023 annual report published by the National Oceanic and Atmospheric Administration, the average annual temperature of the contiguous United States was 2.4°F above average ranking the fifth warmest year on record. There were both temperature and precipitation record breaking extremes experienced across the continent (NOAA,

2024). As discussed above, the most recent revision of the USDA PHZ map shows that Zones in our Midwest region are shifting warmer, and there seems to be a greater number of microclimates. Shifting precipitation patterns are causing real time impacts in our landscape, as well. We are experiencing more frequent and longer periods of abnormally dry conditions across Illinois, while periods of rainfall are short and more intense. We think that the decline of our mature oaks at the arboretum is a direct result of these changes, with these abiotic stresses resulting in compromised root health and increased susceptibility to soil-borne root rot diseases.

If we are expected to develop resilient forests for a future that is compromised by climate change, we will need to think outside of our climactic and provenance assumptions. What is "resilient"? According to Merriam-Webster, it is defined as "tending to recover from or adjust easily to misfortune or change." How is resilience developed? Perhaps it is through exposure to stressful environments, fostering a need to adapt to ensure survival. How do we know what plants have experienced? We can certainly make some educated guesses based on provenance; however, if we only rely on that, then we fail to consider species like the cedar elm in climates like those found in Chicago, Boston, and even Omaha, Nebraska—all places where cedar elm can be found growing outside of its normal range. Instead, it may be worthwhile to push the boundaries of our assumptions, to evaluate more individuals of a given species, and to identify individuals to be used in tree breeding programs as breeding parents or perhaps introduce some chance seedling selections. Most importantly, we will need to increase the taxonomic diversity present in all landscapes inhabited by humans to ensure we have healthy living environments. All these potential efforts have been highlighted as research and development priorities by the USDA Woody Landscape Plant Germplasm Committee in their most recently published crop vulnerability statement (Pooler et al., 2024). *Ulmus crassifolia* is just one example of a tree species that could be added to our planting and nursery production palette.

In a study examining the potential drought tolerance of a wide range of species found in the living collections of public gardens, the authors note that our living collections are an invaluable resource for determining which trees to select for planting in municipal forests both today and in the future (Hirons et al., 2020). As gardens holding living collections, the best strategy we can employ to ensure there are plants for evaluation is to develop quality collections of a diverse range of species with accurate records and biological replicates. In the case of cedar elm, there certainly have not been enough individuals grown and evaluated in public gardens across North America. Currently, there are only two active accessions available through the USDA National Plant Germplasm System, representing one population in Louisiana and one in Texas, indicating there is a significant gap in provenance representation. There are certainly opportunities to capture the genetic diversity of these trees across their ranges through plant exploration.

While it may seem natural and just to maintain ecosystems as we have observed them in our lifetimes, or even to restore them to what they were in the past, there may also be value in being open to the possibility of change. As a species we have certainly caused harm to the other organisms on the planet, and it is laudable to pursue a path of redemption. Yet we might temper our enthusiasm for redemption through the elimination of species that are highlighting our flaws. Perhaps there is a balance we can strike through encouraging diversity of all kinds in our landscapes, including those that are not native. Let's take the advice published in 2011 by Davis et al., captured in the title of their note to *Nature*—don't judge species on their origins.

When I stand in front of this curious tree represented by the numbers 385-68*1, I can ask the question, "Where are you from?" The answer is simple enough to determine. The database tells me, "Seguin, Texas by George Ware's hand." But when you turn around and ask the same of me, the answer is a bit more complicated. It lies somewhere between a rice farm in Korea and an orange grove in Florida. For each of us, our provenance does not dictate our potential, but rather equips us for what prospects may come.

KIM SHEARER *is director of collections and curator of the Morton Arboretum. Her favorite plant exploration partner is her dog, Maybelle Jones. They live in Chicago where she observes urban street tree and park plantings, and informally evaluates plants in her urban container garden shared with three Chicago alley cats. Her mother was raised on a rice farm in Korea and her paternal grandmother was born in an orange grove in Florida.*

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LANDSCAPE HISTORY

Arboreal Codes

Trees as Legal and Social Bodies

By Shannon Mattern

Before one could head down to the local assessor's or county records office, consult a deed, or review a plat to ascertain the boundaries of their own property, they might have instead consulted the trees. Red maples and boxwoods and white pines commonly served as substrates for the codification of territorial claims. Until 1886, surveyors in New South Wales, Australia, were required to use trees to mark the corners of a piece of property. They'd find an appropriately sturdy specimen; cut a blaze into its trunk, exposing the solid wood beneath; then carve in the number of the owner's allotment.[1] If the corner of a plot was signaled with some other object, like a rock or

Tosa Mitsuoki (1617–1691), Autumn Maples with Poem Slips, c. 1675. Art Institute of Chicago 1977.157, Kate S. Buckingham Endowment. *CC0*

an iron post, surveyors—then and even now—would sometimes use nearby trees to "witness," or point toward, the corner, or to trace the line between those corners. They'd chop a series of horizontal lines into the border trees' trunks, and those scars would brand the property boundaries for decades to come.

Paint and colored plastic ribbon, or "flagging," can also serve as less invasive, but also less permanent, arboreal markings. In a timber forest, where the trees themselves are meant to be ephemeral, colored paint and ribbon codes—which vary from region to region, and from timber company to timber company—can flag those trees destined for felling or those spared such a fate, aid in record-keeping for forest inventories, or signal ownership. While forestry organizations have long sought to set standards for such arboreal codes, forester Steve Nix explains, his lot "are an independent breed," and "many see their tree marking designs and system as their personal or company imprint or brand."[2] The marks etched or chopped into bark signaled the identity of those who staked a claim to the tree and the land on which it stood—and, consequently, established social and legal relations between the individuals or parties on either side of the dendrological divide.

As Estonia fell under the control of the Germans, Danes, Swedes, and Poles between the 13th and 16th centuries, those spatial divides shifted, and the colonizing forces mandated more regimented means of demarcating boundaries. Feudal contracts in the 14th and 15th centuries and maps from the 17th century commonly identified both standing and fallen trees and stumps of all species—oaks, birches, spruces, pines, aspens, and alders—as boundary markers. In the field, those trees were often marked themselves, with stripes or notches, with the bishop's crozier and lily, or with crosses. When, in the late 17th century, Swedish authorities mandated that landed property boundaries be marked with less morphologically variable emblems, like stones or charcoal pits, the use of boundary trees fell out of favor—yet the cross persisted as an arboreal inscription, now with a new commemorative and spiritual function. Trees had long been central to Estonian folklore, as historian Ülle Tarkianinen explains.[3] And starting in the seventeenth century, mourners began cutting crosses into trees as they traveled to burial sites; those marks were meant both to memorialize the dead and to keep them from coming back to haunt the living.[4] "In both cases the tree with a cross denoted crossing a kind of boundary," Tarkianinen argues: "in the first case, the boundary between earthly possessions, in the second, the boundary between life and death."[5]

As these historical and contemporary examples make clear, trees have served as more than mere substrates for legal codification of property. Their markings have also served in accounting and commemoration. Yet those inscriptions aren't the only means by which trees constitute legal declarations. Through their stature, species, and position, trees also serve as arboreal embodiments of socio-spatial codes. Arthur D. Peterson writes that, in Iowa in the 19th century—and likely in other settler colonial territories—the "regular taking of timber could satisfy the requirements of continuous, actual, open and notorious possession necessary to establish title" to a land; in other words, by regularly and openly harvesting trees, one was eventually entitled to claim ownership of that land.[6] Around the same time, in pre-colonial Kenya, trees often served as boundary markers in customary land tenure practices, which

ATTENTION
willfully destroy, deface, change or remove
Government Survey Corner or Monument; or to
willfully cut down any Witness Tree or Blazed Tree
marking the line of a Government Survey, is punish-
able by a Fine of $250.00 or Six Months Imprison-
ment, or both
(Sec. 57 Criminal Code of March 4, 1909.)
1861
©#1
BLAZE ON MULLAN TREE NEAR
4TH OF JULY SUMMIT

Image of a blaze and carving on Mullan Tree near 4th of July Summit in Idaho (1927).
Retrieved from Library of Congress

prioritized communal stewardship by mbari, or subclans, and distinguished between rights to control land, on the one hand, and rights to use and access it, on the other.[7] *Mugumo*, "a widely recognized and fast-growing tree with magical qualities," was commonly used to mark boundaries between clans' land holdings. The species was not allowed to propagate on its own; only specimens planted intentionally were permitted to grow to maturity. Their presence thus "indicated something of importance such as a githaka (a sub-clan estate) boundary or a ceremonial site."[8] Other species—*mwatha*, *muiri*, *mukawa*, *muringa*—were also useful in marking boundaries "because they could be easily recognized, because they were easily propagated... and because they had some utility or medicinal value."

In 1929, after the arrival of British colonizers, the Committee on Land Tenure in Kikuyu Province recommended that only mugumo trees and itoka lilies be used as boundary markers, and that it be made unlawful to plant these species in lines anywhere aside from a boundary. Chief Native Commissioner G. V. Maxwell laid out these recommendations in a set of draft rules, which were never implemented, most likely, forest advisor Peter Dewees proposes, "because they would have legitimized some sort of customary system of private tenure—a notion which the colonial government strongly resisted."[9] Validating customary arboreal symbols would have challenged the force of colonial rule. The Registered Land Act of 1963 purported to extinguish rights under customary law and to consolidate the rights of control, access, and use in the landowner. This legislation, Dewees argues, profoundly affected women and the landless, who, under customary law, would have had the right to access and use trees, but lost those rights when they passed to private landowners, typically privileged men.[10] Trees thus came to signal restricted human access to and use of land, as well as use of their arboreal kin within those boundaries. Yet Dewees reports that, in more recent years, state land administration has effectively abandoned the 1963 act and returned to customary distinctions between ownership of the land and of the things growing on it.

Just as colonizers attempted to strip the mugumo of its capacity to encode customary law, U.S. legal historians, again privileging English colonial common law, tend to overlook the capacity for historical "metes and bounds" methods—"systems of demarcation dependent on ... movable stones, impermanent trees, and transient neighbors"—to encode localized knowledge and scaffold community relations.[11] The network of notched trees was only one component in a larger socio-technical system. As legal scholar Maureen E. Brady explains, colonial American metes and bounds were often "supported by a variety of social and legal practices" that facilitated the enforcement of boundaries and transfer of land; those practices included "the ritual walking of boundaries, legal processes for communal boundary upkeep, and highly regulated land distributions to closed populations," all of which "helped to reinforce shared understanding of the customized descriptions in deeds" and to cultivate witnesses.[12] Perambulation, for instance, involved gathering the community—adults and children—to walk around the relevant property and, while doing so, to strike the boundary line and any boundary markers with branches, sticks, and stones.[13] This social peripatetic, ceremonial pedagogy sought to inscribe those boundary lines in participants' memories—for generations—and to contribute to the regular maintenance of boundary markers.

Compared with modern means of demarcating land boundaries, "standardized to facilitate market transactions and yield economic development," metes and bounds were inefficient. Yet they yielded "thick, customized information ... tailored to the specific needs and preferences" of a local community.[14] The arboreal apparatus of metes and bounds "performed important social and legal functions in tying colonists to the land" and to each other, Brady argues, "facilitating compliance with a brand-new system of institutions, and controlling access to outsiders," which promoted community cohesion and accountability.[15] Standardized maps and deeds, which arrived as populations grew and diversified and as land became more scarce, eventually opened up and regimented those markets–while also disentangling them from the local social fabric.

While the disappearance of metes and bounds and customary land tenure models may have diminished the social aspects of arboreal property demarcation, the trees rooted on those property boundaries—and the commitments and codes informing arboreal care—still interconnect the neighbors and broader communities that enjoy the trees' shade, beauty, and bounty. "We have a 150+ [year] old oak tree on our property. Its branches cross several property lines," Lisa Hermsen, a rhetoric scholar, told me on Twitter. "Negotiating how to prune the tree so as not to harm it has been incredibly communal. We all love the tree."[16] Those parties negotiating their shared

Hendrik Voogd (1768–1839), *Fallen Tree*. Harvard Art Museums/Fogg Museum, Loan from William W. Robinson and Nancy E. Yocco, *Photo © President and Fellows of Harvard College, 5.2004*

obligations, she notes, "include the arborist as well as the insurance company and the electric company. And many talks across fences at leisure. Branches do fall," she acknowledges, and such incidents typically highlight for this cast of stakeholders the tree's myriad forms of worth: as an enhancer of property values, as a provider of apples and cherries, as camouflage for unsightly utility company equipment, as a home to treehouses and squirrels, as caster of shade for picnics and pontification. In assessing how to address their boundary-tree's needs, Hermsen says, we're constantly "balancing [the] interests of the tree and of everyone's home and safety."[17]

Such matters aren't always left to informal negotiation. Trees serve as an organic infrastructure for the legal delineation of property boundaries—and the trees that reside within and on those boundaries are then subject to their own laws regarding landowners' arboreal rights, responsibilities, and liabilities.[18] It was once the case that, if a tree drew nourishment from adjacent properties, the tree belonged jointly to those various landowners.[19] This alimentary model of arboreal custody then shifted to a morphological model—one equating the tree with a particular part of its anatomy. Today, in the U.S. (and perhaps elsewhere, too), the ownership of a tree is typically determined by where the trunk is located; the keeper-of-the-trunk has the right to do whatever they wish with the tree, regardless of whatever comfort or enjoyment it provides to those nearby. Any fruit born by that tree, even if it dangles from branches that hang over the neighbor's fence, typically belongs to those who steward the tree's trunk—particularly if those trees have commercial value to the owner, as in an orchard. That said, the neighbor is, in most states, legally permitted to keep fallen fruit, since it likely has little value to the owner, who wouldn't be able to retrieve it without trespassing anyway. Fallen leaves and twigs, however, are considered a general nuisance without a specific "owner"—which might displease those who live downwind or downhill from a neighbor's acorn-shedding red oak.

If a storm downs a branch or topples a tree, causing damage to a neighbor's property, the tree owner

Sir James Guthrie (1859–1930), *In the Orchard* (1886). National Galleries of Scotland, NG 2866.

Retrieved from National Galleries of Scotland, CC-BY-NC

can be held liable if the tree was visibly unhealthy or unstable. Such obligations depend in part on where these neighbors live: urban landowners, including municipalities, are commonly expected to inspect their trees for decay and to eliminate any potential dangers, while such obligations are regarded as excessively onerous and impractical for rural residents. In a few jurisdictions, landowners are held liable for "artificial" vegetation they have planted and maintain themselves, but not for "natural" vegetation; such distinctions are often rather shady.

If a tree trunk straddles multiple landowners' properties, as is the case for Hermsen, the tree is common property, and any alteration to it or distribution of its fruits requires communication and agreement between the joint owners. If a tree is planted squarely within the boundaries of a particular landowner's yard but the trunk grows into an adjacent property, its ownership depends on the state in which it lives; in some states, the original owner retains ownership, yet in others, the tree becomes common property. If branches or roots encroach on a neighbor's property, that neighbor, in most areas, is entitled to "self-help"—which might entail cutting any infringing appendages back to the property line, provided such alterations don't damage the tree. Public utilities, who might be installing new infrastructure or widening roads, also typically have a right and an obligation to remove arboreal obstructions by doing only what is "reasonable and necessary."

If a neighbor or utility does cause damage to the tree, the owner can sue, and they might be entitled not only to compensatory damages—determined by factoring in the trunk's volume, the species, and physical condition—as well as "the difference in the fair market value of the property before and after the injury or the cost of restoring the property, whichever is the lesser amount".[20] If the tree is damaged willfully or with malicious intent, the owner could be entitled to treble damages, or three times the amount of the damages. Such calculations operationalize the tree as timber or as impact on property value. Yet the law does sometimes recognize other forms of arboreal value: some jurisdictions allow for the awarding of

The Station Oak today (left page) amid modern tree-entangled infrastructure on the Natick/Weston town line. A sign indicates its role in the “Livermore Survey” of 1749. *Photo by Claire Neid*

additional damages to account for the tree's "intrinsic" value —which encompasses its utilitarian value (e.g., its provision of shade) and ornamental value—as well as its sentimental value or its part of a larger assemblage, as in an orchard or windbreak.[21] Still, as legal scholar Alyse Bertenthal argues, in tree law, "the victim is never the tree, only the owner of that tree.... Although it may have sustained the impact of wrongdoing, the tree remains only a measure of human loss, not the bearer of that loss."[22] Even Christopher D. Stone, in his classic *Should Trees Have Standing?: Law, Morality, and the Environment*, from 1972, and those jurists profoundly informed by his work, still mostly frame arboreal rights in anthropocentric terms.[23]

Tree disputes are "never just about the trees," tree lawyer Barri Bonapart told *Atlas Obscura*'s Natasha Geiling. "The trees often serve as lightning rods for other issues that are the psychological underpinning of a dispute that people might have with each other."[24] Arboreal law—both that addressing trees as markers of landed property and as property themselves—is about capital, colonialism, commemoration, the commons, and community. It's also based on establishing trees themselves as bodies, as ontological beings, that mediate the relations between human and social bodies—from neighbors to nation-states—in space. Does the law conceive of a tree as a mere commodity: something to be transformed into lumber or to enhance the market value of a home? Does the law define a tree's being based on where it derives its sustenance—that is, where its leaves and roots draw sunlight and nutrients from the sky and soil—or by where its trunk happens to rise from the earth? What about the branches and the roots: when they cross a property line, create obstacles for utility companies, or obscure million-dollar views, they seem suddenly to become ontologically separate from the trunk. And what of the leaves and fruits affixed to those branches? Their essentiality to the tree-as-legal-entity seems to depend on whether their crop is on the branch or on the ground. How, then, do we think about the tree's other incidental properties and capacities: its provision of shade and shelter for multiple species, its production of oxygen, its consumption of carbon dioxide, its capacity to prevent erosion, its contributions to community wellness? Are these properties not part of the tree's "intrinsic value," too?[25]

Given how expansive and communal are its provisions, it seems absurd to regard the tree as privately possessable property. The lengths to which jurists have gone to reconceptualize the tree—lopping off its roots and branches when they don't fit the rubrics for legal assessment, framing its value in relation to the real-estate or timber market—attest to the tree's resistance to such reduction. To then enlist the tree in the work of legitimating a regime that reduces land to property—a colonial system that, as Brenna Bhandar explains, "naturaliz[es] possession and occupation"—ultimately constitutes a reduction of the social world, too. Private property, Bhandar writes, consolidates "language, ways of seeing, and modes of subjectivity that render indigenous and colonized populations," especially those who do not regard the world as possessable, "as outside of history, lacking the requisite cultural practices, habits of thought, and economic organization to be considered as sovereign, rational economic subjects."[26] Yet as Potawatomi plant ecologist Robin Wall Kimmerer argues, it is instead the settler preoccupation with property that is impoverished. "In the settler mind," land is "real estate, capital, or natural resources. But to our people, it was everything: identity, the connection to our ancestors, the home of our nonhuman kinfolk, our pharmacy, our library, the source of all that sustained us. Our lands were where our responsibility to the world was enacted, sacred ground. It belonged to itself; it was a gift, not a commodity, so it could never be bought or sold."[27]

The trees on that land are all these things, too: they are emblems and embodiments of broader, deeper land politics and social relations. Kimmerer describes how "pecan trees and their kin show a capacity for concerted action, for unity of purpose that transcends the individual trees. They ensure somehow that all stand together and thus survive."[28] Settler colonialism instead positions trees, and the land that sustains them, as individuated, parcelable commodities—as points and lines on an atlas of social friction and division. The trees themselves clearly refuse this diminution, stretching their roots, poking their branches, casting their leaves, throwing their shade wherever they please, regardless of who owns the land below.

SHANNON MATTERN *is the Penn Presidential Compact Professor of Media Studies at the University of Pennsylvania, and the Director of Creative Research at the Metropolitan New York Library Council. Her work focuses on archives, libraries, media infrastructures, and spatial epistemologies.*

Editor's note: The author began this essay in 2021 for an edited volume responding to Paolo Patelli's and Giuditta Vendrame's Friction Atlas, *a public installation exploring "the enactment of laws on public surfaces." When that volume did not come to fruition, the author posted it online, and we invited her to share it with readers of* Arnoldia.

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That Soft Attention to the Sun

By Carson Colenbaugh

I have always been anchored to and loosed from the rest of the living world through language.

Raised in Kennesaw, Georgia, a suburb north of Atlanta, the woods I knew best as a child had an unmistakable density: secondary forests packed with saplings and shrubs. And yet, those species existed with blank nametags that friends and I could only fill in with our own artistic flair.

After taking up exploring as a primary pastime, my interests shifted from fictional characters to those attentive to the world around them, like Darwin. But such influences took my curiosity away from home. Though surrounded with diversity, I pretended my local forest was actually in Borneo or the Amazon. It wasn't until my time at Clemson University, which kicked off in Dr. Don Hagan's dendrology class, that I learned about those I had always lived among.

As a child, I thought science was still largely a practice of collecting, illustrating, and taxidermy. By high school, I'd learned otherwise. But at Clemson, I found fresh interests in the topics of fire ecology and novel ecosystems, assisted with graduate research projects, and became a prescribed fire technician with the Fire Tigers.

Still, though I developed a love for scholarly writing, my scientific experiences required an outlet that could convey both data and drama. Poetry became this practice. Thank you, Walt Hunter, who supported me without question when I mentioned I wrote poems and who interrupted me when I was about to introduce myself to one of his colleagues as a horticulturist.

"Carson? He's a poet."

These days, I do my best to balance both ecology and creative writing in a relationship that at its best is mutualistic and at its worst is predator–prey. I've continued forestry research with Dr. Hagan in my free time as an MFA student, and I'll pursue a PhD at the intersection of horticulture and forestry in the near future. Though a career in writing would be a dream, I'm desperate to be for others who Don Hagan is for me.

If I consider the following to be "nature" poems, it's solely because they're concerned with documenting and deconstructing the material world. Love, lust, longing: these are my textures, never topics. To use the lingo of mentor J. Drew Lanham, my poems are both field guides and *feel* guides. I wrote them to create beautiful lectures, a unique archive, an herbarium-in-verse. Some days, I think I succeeded.

CARSON COLENBAUGH *is a poet and forest ecologist from Kennesaw, Georgia. His work has been published or is forthcoming in* The Southern Review, Southern Humanities Review, Terrain.org, Birmingham Poetry Review, *and elsewhere, including* Human Ecology. *He is a 2024 Tor House Foundation Fellow and can be found on Instagram @carsoncolenbaugh.*

Opposite: Clemson University Creative Inquiry students search for fire scars on Currahee Mountain near Toccoa, Georgia. *Photograph courtesy of the author*

Dying a Slow Death

Shaken to a halt in the stadium's lot, I find
the sky alight, fracturing in cadmium,
smelling of corpses: maybe a brushfire burning
through close meadows, or acres over the mountains

set aflame by slipped-up old folks, teenagers
mishandling fireworks, faulty cables bleeding
devastating sparks. Had I a better nose
the true toll could be clearer, slight hints perhaps

waltzing through nostrils; notes of wind-thrown hickories,
derelict pine-rows, snuffed oak-saplings. But clogged
sick with cold, I can only pick-up on smoke,
its clear presence, high strands shadowing the ground.

Whatever it is, it will pass. Pruned soil will cool,
will starch: uncovered, inviting drought: a slow demise
brought about by the hot death of root-hairs and moisture's
evaporative absence. Sourwood, sassafras,

hemlock, other hill-dwellers will tighten drink-starved,
emaciated as bronze-cast ascetics
by these unrivaled fires. Then comes onslaught by pests,
beetles & fungus; then comes the next ignition's fuel.

I remember Rough Ridge. I remember Rock Mountain.
We named those blazes after what they strangled,
rotten duff they ravaged when I was just a boy.
Smoke gathered over school at seven in the morning

spilling awful carmine scents of chemicals
to waft on the air. Forests northward torched, fading
via quick capillarity, unmystic bloodletting.
And the new fumes roll over the lake. They'll likely

reach the hospital by ten, or the next town over,
and may yet hunch to the coast. All I can say,
the extent appears great: ash-blots up each branded side,
black char over bark. Birth & climax, perch-mates.

Clemson, South Carolina

Anecdote on Errors & Residuals

Arborists came, cut them down: necessary harvest:
tuliptrees teetering above our house, bent-over

& flexing tension-wood. Now their flat stumps run
flush along the hillside and mobs of new shoots

have begun grand ascents. Nothing cropping-up seems
worth a survey. Rattlesnake fern, striped wintergreen,

wild yam: lost beneath stiltgrass that surfaced, transpired
without hesitation following the first hard

touches of light on loam since the poplars seeded
at my birth over twenty years ago; all smothered,

beaten-back by novel competition's constant front
and condemned to ever-forming stabilities.

Cruising the highways, reports flash more of the same.
Recent barriers run their paths. Kudzu peeks

its trifoliate head through cracks, nowhere left
to charge but over, having consumed its woods-edges

just as stiltgrass chokes-out clear ground if not guided,
each creeping ecstatic through unclaimed light, their powers

nurtured by carbon converting atmospheres
into fodder, reminding me always of the heat

yet to come & every advertised waning winter,
my stony inaction, caustic smoke in place of sky.

Wouldn't everything have been easier had our foes
stitched violent flags, raised artillery worth spying-on,

broadcast messages of destruction or messages
at all, and not been like us in nearly every way

aside from indumentum, stoloniferous spread,
that soft attention to the sun I never could match?

Kennesaw, Georgia

In the Shadow of Kennesaw Mountain

Rounding this battlefield in my warmest coat, hands
tucked snug in wool pockets, I turn an intact
acorn cap, robbed of a red oak's dormant fruit.

Dogs & their walkers pass slowly overgrown
wagon-trails as they spill-away toward scrubby woods,
reduced into beds of growth. In the underbrush

deer munch greenbrier prickles, immune to its tender
bayonet-prods and always browsing, perhaps knowing
only fables of mortarfire. Some futures sprouted

among the weary earthworks. Now elms & gums threaten
wanton destruction. Houses, too, have landed
siegelike in the woodlands & around the field,

which is weedwacked-back every year to maintain
a looming vacancy. Developers work hard
fighting to strip prairie to stone. Still, the past arrives:

roots raise beads, buckles, buttons; cannon outcrops
become a hiker's respite. Once I found a bullet
and buried it, mistaking sullied lead for seed.

Kennesaw, Georgia

Landscape with the Gaze of Abraham

...and, lo, the smoke of the country went up as the smoke of a furnace.
GENESIS 19:28 KJV

This afternoon, bounding through hilltops above
the Bootleg Mountain Fire's matchstick waste: my rosy skin
draped in crisp shade, thick sunscreen, & pillars of sweat:
irregular ripples collected as low peaks,
prominent knobs left mostly untitled that tilt, pull

scorch up their hides. Two years prior, Bootleg sweltered,
its outcrops now exposed, its slopes well-seasoned
with blends of heat & crunch. There the final turkeybeards
bloomed, spilling over themselves in lace, a result
of burnt crowns. Combustion signals coming decades

free from fire, periods worthy for white flowers
to emerge from the maws of once-furnaces:
turkeybeard, *Xerophyllum asphodeloides,*
no name sufficient to describe how they convulsed
gossamer in petals, inflorescences

ecstatic to grow and greet a xeric life
surrounded by goat's rue & black huckleberry
& Table Mountain pine, neighbors hindered elsewhere
by recent mesophytic earth. Carbonized specks
coated recovering ground as we rucked toward

our survey-plots, and the lake's fog rose dense as smoke
must have risen off that tight topography, where
gasping over miles of teal air we witnessed
rarities revealed even as their neighbors buckled
into stand death, snags blistered & shivering.

There are many things better-off in ruins,
why some claim He flooded antediluvian lungs
to invent the spin-off sitcom, or struck-down Babel,
scattering expression, or overthrew cities
& fertile plains. Such frequent disturbance intervals

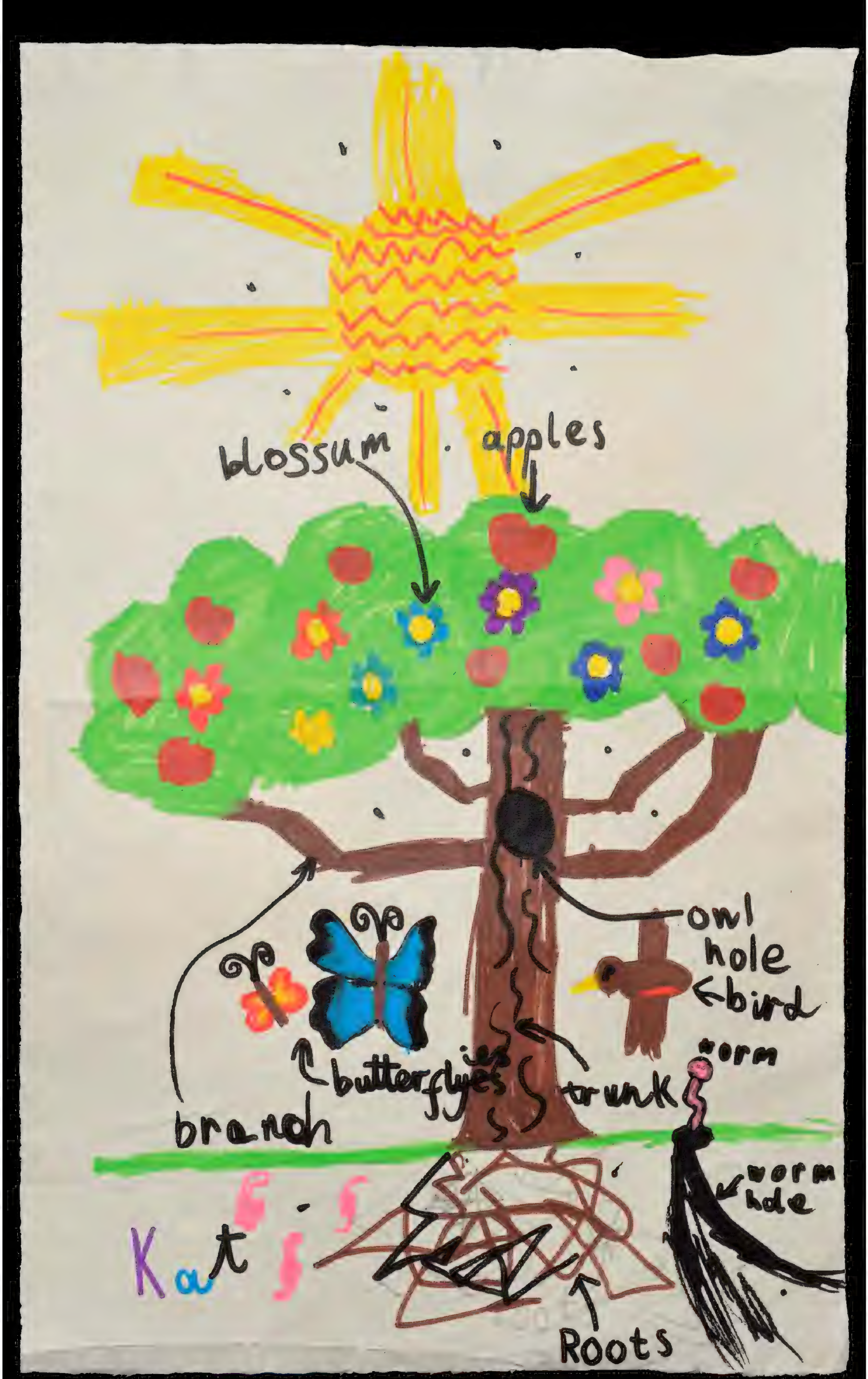
allowed for the rainbow's supposed covenant,
choral diversity, survival. The value
situated in such things lies not in the stable
lifelessness of bonds but in their severance,
explosive energy within: forces found

erupting in uranium after staccato
bombardment by neutrons, atoms in the garden
and the world in pieces. Or via hydrolysis,
forming silicas that build-up tides of sand & stone
scattered over land waiting to sear itself.

On down-mountain roads, yesterday's detritus still frosts
our truck in hillcane, deertongue, gravel-dust. Soon
it is evening. At the street corner, students shout
ten-thousand warnings; impressions of crushed marble
clog roadside gutters like cold grease; bricks run crimson

with tortured mortar. All symptoms of escalation
I suppose, bonfires amassing above tinder.
Weeds emerge from faults in masonry, tentative promises
soon for flowers. Haze-dusk cuts up sky into cubes.
There's a light wind from the west on the shattering streets.

Pickens County, South Carolina


blossum
apples
owl
hole
bird
worm
butterflyes
trunk
branch
worm
hole
Kat
Roots

INTERVIEW

"Not an Isolated Thing"

John Kress and **Michael Dosmann** talk about *Trees of North America*

"I have spent my life more with plants than with people," John Kress observes in this conversation with the Arboretum's Michael S. Dosmann. The reason for their chat was the publication of Kress's magisterial book, *Smithsonian Trees of North America* (Yale 2024)—a book which, as Jonathan Shaw of *Harvard Magazine* notes, "is not intended as a field guide," but to "encourage readers to identify with trees." With Dosmann, Kress opens up about his lifelong relationship with trees and the natural world more broadly; how the book's rich photography (which Shaw rightly calls "stunning"... elevating tree fruits and flowers, buds and branches, leaves and seeds to an art form that rivals any other") grew out of the author's pioneering early work developing digital tools for plant identification; how identification—whether of trees or with them—isn't complete without full consideration of their value: not only ecological and aesthetic, but individual and organismic; not only to humans, but to the nonhuman world. —*Arnoldia.*

Michael Dosmann: In the very front of the book, you write about the value of trees. How do we evaluate—not *evaluate* necessarily, but *value* certain trees? I mean their cultural value or aesthetic value; their ecological and economic value. Why do we do this? What does that tell you about us humans?

John Kress: That was one of the very core things I wanted to do with this book. I did not intend at all to build up an identification guide, and obviously given the size of the thing, you're not going to carry it with you. I had done that with Leafsnap,* [*an iPhone app, developed at the Smithsonian Institution under Kress's direction, which used visual recognition to identify tree species in user photographs.] and that was more focused on identification. But you know, as a botanist, I've spent my life more with plants than with people, to tell you the truth. And then, when I'd see people who hadn't spent that much time with plants, I really felt like I needed to somehow convey how I developed this respect for

"My grandaughters.... understood that a tree was not an isolated thing: the tree had all these parts, and was associated with birds and worms and squirrels, and had fruits and flowers...." *Art by Katherine Hawksby, age six*

John Kress is research botanist emeritus at the Smithsonian National Museum of Natural History. His book, *Smithsonian Trees of North America,* appeared in September 2024.

Michael S. Dosmann is the keeper of living collections at the Arnold Arboretum.

Branch and fruit of *Cercocarpus montanus* featured on page 427 of *Smithsonian Trees of North America* (Yale University Press, 2024). *Photographs by John Kress*

the natural world—and I don't want to just say plants. I want to say, *the natural world.* And I thought, gosh—I need to show people that there's all different types of value to these things for their own lives, but also for the planet. for ecology, for the atmosphere. You know all those things, and the more time I spent in cities where people are, the more I really wanted to get people to look at these things wherever they could. Even if it's a street tree on Constitution Avenue—I wanted them to look at that and suddenly realize that there's something there, not just as a species or a horticultural specimen, but as an *individual.* And so, I said, I need to show the aesthetic value. I need at least to discuss some of the economic values.

Take those two drawings by my granddaughters. They live in North London, (and) London's pretty full of trees, but it still is an urban setting, and I wanted to know, what did this six-year-old and this eight-year-old think a tree was? And they came back with those lovely, great little drawings, which are framed on my wall right now.... Because they showed how they understood that a tree was not an isolated thing: first of all, the tree had all these parts, and was associated with birds and worms and squirrels, and had fruits and flowers ... I'm not sure if this is answering your question. But I felt that that those two drawings were inspiring to me. And I wanted to somehow take that inspiration and put that in the book.

MD: What do you think your book might look like if you had written it in 1924 rather than 2024? Are there things that you as

a scientist of an earlier era, a botanist in the 1920s, might have included as dogma, that you have left out a century later? Or on the flip side, are there any things that a 1924 John Kress, in reading this 2024 book, would say, What the heck are you putting that in there for?

JK: Yeah, there are books that were written in the same era, but not quite 1924, like Peattie (Donald C. Peattie [1898–1964], botanist who authored many books about the natural world, including *A Natural History of Trees of Eastern and Central North America,* Boston, MA: Houghton Mifflin Company, 1950; and *Natural History of Western Trees,* Boston, MA: Houghton Mifflin Company, 1953) and others, (and) I actually loved going back and reading them. Most of them were not heavily illustrated—they may have had some hand drawings or some line drawings in black and white, but nothing that I could put in a 2024 book. Secondly, the world has changed enormously since 1924. And from the introduction, (my book) explains that we're in dire straits right now as a planet, as a people, as biodiversity, and so that puts trees in a very different perspective. I don't think anybody in 1924 was writing about the impact of trees on carbon sequestration or that sort of thing, whereas I mentioned that throughout—in fact, I even talk about (it) for each species. But you read Peattie, and his accounts of trees are so inspiring and so lovely. And you could see he knew, I mean, I'm envious, because he knew every species so much better than I know every species.

I was trying to give the reader a real, complete feeling for the different, intricate parts of a tree.

MD: You wrote this book after several decades of practicing botany. Do you think anything would have changed had you written a book like this in as an early career scientist?

JK: I think the thing that changed was the perspective. You know, I took my first real trip to see biodiversity with Richard Evan Schultes at Harvard as an undergraduate. (We) went to Colombia, and it hasn't stopped since then. I spent a lot of time in the field, and that completely changes how you look at things, as far as I see and how I look at trees. I think those years, those decades of experience getting to know what nature is about, through thick or thin, gave me a different perspective that I would not have had when I started.

MD: You include over 300 different species in this in this book. And each species treatment includes a range map along with some basic descriptive morphological detail. How did you determine what was essential for each one and what was to leave out? Did that template change at all from when you first started writing the book?

JK: It did, because this thing started with Leafsnap, which was primarily a photographic way of identifying 200 trees in the Northeast, and it had very short descriptions. When I really got into the book, I saw how kind of trivial they were, because it was an app, not a book. And then I started thinking of what I just was describing to you: what is the essence of a tree, right? It's not just a leaf, it's not just a bark, but it's all the other parts that you put together. It's the top of the leaf, the bottom of the leaf. I didn't include buds, and I've gotten a little flack for it. And as you see in the book, in some species, I only had a leaf or a bark, and that was partly because of the pandemic. So I did leave a few holes in there, but I was trying to give the reader a real, complete feeling for the different, intricate parts of a tree. And then the further I went, as I said earlier, I also thought about the plight of nature today, so I've got to talk about something about their conservation status. And I got into climate change, I realized the US Forest Service had done this climate change assessment of (some but) not all of the species. And I wanted to emphasize that as well, that this species has still not been (assessed). And then I also wanted to have something in there about the value in

ecology of trees. It just didn't make sense not to say something about the interactions with the squirrels and the butterflies and everything else. I tried not to get too carried away, but I wanted to give a little complete picture, right?

MD: Getting into the species list: I mean, over 300 different species are listed. I'm not going to go in there and ask you for listing favorites. That wouldn't be fair—

JK: You know, I have 326 favorites in that book.

MD: It's like asking somebody their favorite grandkid. Do you have an example or two of some species that you were just casually aware of, and that through writing the treatment, looking at photographs that you've taken, or samples that people have sent to you, that you were able to gain a greater appreciation or newfound respect?

JK: Yeah, the first one that comes to mind, and that's a great question, is *Cercocarpus*.

MD: Oh, really?

JK: If you look on 424 and 426, there's the two species (*C. ledifolius* or curlleaf mountain-mahogany and *C. montanus* or birchleaf mountain-mahogany). I didn't know (them). In fact, I couldn't get anybody to send me material of this, even though I know it's common. So those photos are taken from the US National Herbarium.

MD: Those are great.

JK: I mean, look at the structure—look at the hairs on those spiral fruits. I learned a lot about that plant, just the beauty (of it). I wish I would have had flowers, and looked at the whole thing, and I didn't, but that's what I had. I put together a whole plate of images that I photographed from herbarium specimens in the US National Herbarium, just to thank the collections people there for taking care of these specimens, for that stewardship, and also to emphasize what we still can learn.

MD: Were there any plants that you had a hard time forcing yourself to follow the two-page template, where you felt that it was just too difficult to cram all the narrative on the one page?

JK: I think if you just flip through, and I'm not going to do it now, but if you flip through and you will see where there are ten or twelve photos of something and a long description that covers the whole page; and other ones, some of the conifers, to tell you the truth, where I didn't have a cone, where the description and the image would fit on one page. But I admit, when we came to the end, almost every species had a two-page spread: 326 times two. Suddenly were, you know, 650 pages. And I thought, Oh my god, this is too much!

MD: Almost 800 pages, beautifully bound, hard cover—it's not really a field guide; it's not for the casual hike or the field expedition. Any thoughts of how this this content could be extended further, maybe even into the digital realm, or other venues?

JK: Actually, I've been talking with my editor, Jean Black at Yale University Press—she helped quite tremendously with this. We were talking the other day and we were thinking, do we want to make regional versions of this? And then we're also talking about a children's version. I have no idea what that would mean, but I'm thinking this is a little hefty for children, but if we could somehow turn this—not into a "children's book," but a version for children. Because, I mean, they could relate!

GARLAND

Addendum: Plant Matter

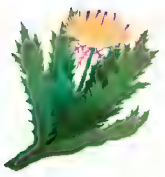
Excerpt from *Winter Solstice: An Essay,* by **Nina MacLaughlin.** 2023 Black Sparrow Press

The following are the plants and herbs most strongly associated with the winter solstice. They're woven into wreaths, decked in halls, hung on doors and in doorways, draped around banisters, slung on mantles, cooked with, made into tinctures and teas, and burned in fires. Besides the below, other plants and herbs with strong links to the winter solstice include: cedar, clove, rosemary, nutmeg, birch, pine, chamomile, juniper, frankincense, and wintergreen.

Holly

Two brothers run the year, two kings, and each one rules for six months. The cheery Holly King, mischievous in the gloried dark, puts on the crown on the summer solstice and lords over the darkening half of the year. On the winter solstice, at the peak of his power, darkness at its very darkest, daylight at its leanest, he surrenders to the Oak King, who'll have the throne as the sun returns itself to earth. And so they make their solstice trades, power handed back and forth as the seasons swap and the years spin round. The waxy prickled evergreening holly leaves and its firm red balls give a cheering lifeblood impression in winter, a blast of bright color in the dun, and a threatening sense as well, puncturing and poison, vaguely cactal. Evil spirits feared the holly, and people brought it into the house to protect against them. It was said to forfend against lightning, too, and planted near houses because of it. It eats the light, swallows it right down, and drops it to the earth.

Illustrations by Jesse Zhang



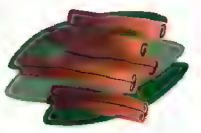
Blessed Thistle

The yellow flower has a dandelion look, a sunburst accumulation of tiny petals. It sprawls itself across the earth and needs full sun to grow. A silky white down furs its leaves. It's known also as the holy thistle or the spotted thistle or *Cnicus benedictus* or Saint Benedict Thistle, after Saint Benedict, patron saint of speleologists, people who study or spend time in caves. A full-sun flower, a namesake saint of dark places. Blessed maybe for its healing powers: it can help diarrhea, swelling, and coughs. It aids in liver function. It can lower fevers and treat bacterial infections. Blessed maybe for the Benedictine monks who used it to soothe the fester and puss of bubonic wounds during the plague. Monks turned it into tonic and chugged it. It's also used as a galactagogue, increasing breast milk supply for nursing mothers, making a milkier way.

Mistletoe

Mistletoe, a parasitic plant, thieves water and nutrients from its host, often an oak. A bird eats the white berry, shits a seed upon a tree, the seed embeds itself into the tree's system, a significant kiss, slipping into its xylem, the place where the mistletoe takes what it needs to grow. In Norse myth, Balder, beloved god of light and joy and the summer sun, son of goddess Frigg and god Odin, had bad dreams about his death. To protect him, his mom made every creature and every object vow never to bring him harm. Everything and everyone agreed. Except mistletoe, which Frigg had never asked. Loki, the disruptor, learned this and made a spear of the mistletoe and joined a game the gods liked to play where they'd shoot arrows and throw things at Balder; every hurled weapon missed its mark. Loki in disguise handed the spear made of mistletoe to Balder's blind twin brother, the winter god, telling him to toss it. He did, the spear reached its target, and Balder fell down dead. Goodnight warmth, goodnight sun. In the underworld, goddess Hel said he'd be released only if everything in the world would weep for him. Everything did, except Loki in disguise again, and so Balder remained. Some say Frigg's tears turned into the white berries of the mistletoe and that they brought him back to life. And so the mistletoe became a symbol of love, kisses all around. Other versions aren't so tidy. The Greeks called it Oak Sperm.

Rattle of cinnamon stick in the jar, dust on your fingertips, a stranger at the door.



Cinnamon

It comes from the innards of the tree, extracted from below the bark and let to dry, and it curls into rolls as it does. Scrolls of rust-colored spice, grated into powder, dusted over the apple crisp, a glass of thick rich eggnog, buttered toast, sugar cookies. A familial smell, a smell that lives in our minds before we've even smelled it, inherited from thousands of years of global trade, of boats and caravans, travelers crossing sea and land to deliver new flavors to the mouth. Cinnamaldehyde brings the smell, an unappealing set of syllables for a smell of warmth, ovens and forests, color of fallen oak leaves, of darkened honey. It's an anti-oxidant, an anti-inflammatory, it lowers blood sugar. It's said to increase circulation, too, widening the vessels, especially in the abdomen and between the legs. More blood flow, more warmth, a special heat, more babies are conceived this time of year than any other. Rattle of cinnamon stick in the jar, dust on your fingertips, a stranger at the door.

Yew

Aged sentinel of the churchyard, scab-by-barked and evergreen, the yew, with its "vast circumference and gloom profound" grows "too slowly ever to decay,"

as Wordsworth told. The trunk crumbles on the inside, and as it does, aerial roots, roots from above, drop into the crumbled hollows and down into the ground, new life in dead space. You cannot tell the age of the yew tree, not in the usual way—no age rings there to count. Their lifespan is tallied not in decades but millennia, and they were associated with the underworld, said to hold life and death not in opposition but twined like light and dark. "Beneath the shadows cast by somber yews, / there is a path that, sloping downward, moves / through voiceless silences—the road that leads / to the infernal world, where sluggish Styx / exhales its fog and mists," writes Ovid in his *Metamorphoses*. They cleansed souls on their way to the underworld. The dead are outside time, and as for plant life on this earth, the yew might get closest to that same sort of spanlessness. Because of this, they're often found by graveyards, roots tickling the dreamless skulls. The bark is the source of paclitaxel, known as Taxol, an anticancer compound that helps halt cell splitting in cancers of the ovary, lung, breast, and esophagus, among other sites of solid tumors. How still the graveyard, how still the church, how still the mossy stones, and the yew tree, quietly, so quietly, grows into its own hollows. You can't hear it happening, but it's happening, new roots growing to fill the voids. And the thrushes and the waxwings come to gulp the berries, the fleshy, gummy cases of the poisonous seeds.

Nina MacLaughlin is the author of *Summer Solstice* and *Winter Solstice* (Black Sparrow), winner of the 2024 Massachusetts Book Award. Her book *Wake, Siren* (FSG) was a finalist for the Lambda Literary Award and the Massachusetts Book Award. Her first book was the acclaimed memoir *Hammer Head: The Making of a Carpenter* (W.W. Norton), a finalist for the New England Book Award. She lives in Cambridge, Massachusetts.

Oak

What's fire's relationship to the sky? Does fire eat sky? Does sky eat the fire? Does the sky burn, feel hurt, cry out, as flames rip into it, as the oak in the fire moves from tree bone to tree dust, silky black ash back to earth? Or does the sky say to the fire, Yes, take me in, turn me to heat, turn me to light, make me disappear? Does the fire say to the sky, Closer, let me touch you? Does the sky say, Fire, dance in me, lick me? Does fire say, Sky, increase me, let me fill you all the way? Does the sky say, Fire, you know when you feel the wind that we are moving together in the ancient way? Is the fire afraid of what will happen? What will happen? The fire will rise, swell, flick, lick, throw shadows on the snow, bring blood to the foreheads, cheeks, and necks of the ones who stand near it. It will feast on the oak, ravenous fire, it will eat the oak, the oak in its potency, its longevity, king tree, door to another world. Fire will feed on tree, and once it's taken what it can from it, and taken what it can from the sky, the glow will grow lower, like a dancer who's danced for days, danced holes into shoes, and faded on the floor. Then, oak eaten, only glow on the ground, the embers will throb with orange heat. And the sky will take the last gray-white strand of smoke into itself and spread it so thin it turns into smell, on the shoulders of the people near the fire, in their hair, in the fur that lines the hoods of their coats, in the fur of the fox that hid nearby to watch the flames because it's the closest the fox gets to looking in the mirror. That last wisp will rise into the night as the eyelid falls over the glow, blinking it to black ash. But an end here does not mean the end. The original fire lives in all fire. On the stove and in the hearth, in the bonfire on the beach, surrounded by stones in the woods by a river, in the explosion after the crash, between your ribs and behind your eyes, on the struck tip of the match, on the burning surface of the stars, the source of our fire, and us all. The fire goes out and lives on. The burnt dust of oak bone will rise, like you someday, and me, like all of us, last branches turned to ash, last branches of the great tree that rooted us, everything, all together, up to where the sky becomes something else, a place that doesn't belong to us, and that tiny speck of tree will continue to rise, invisible, barely there, up and up, until up no longer exists, until it's drawn into the path of the galloping golden horses that pull the sun.

Bonsai in Cold Storage

By Chris Copeland,
assistant manager of
plant production

72

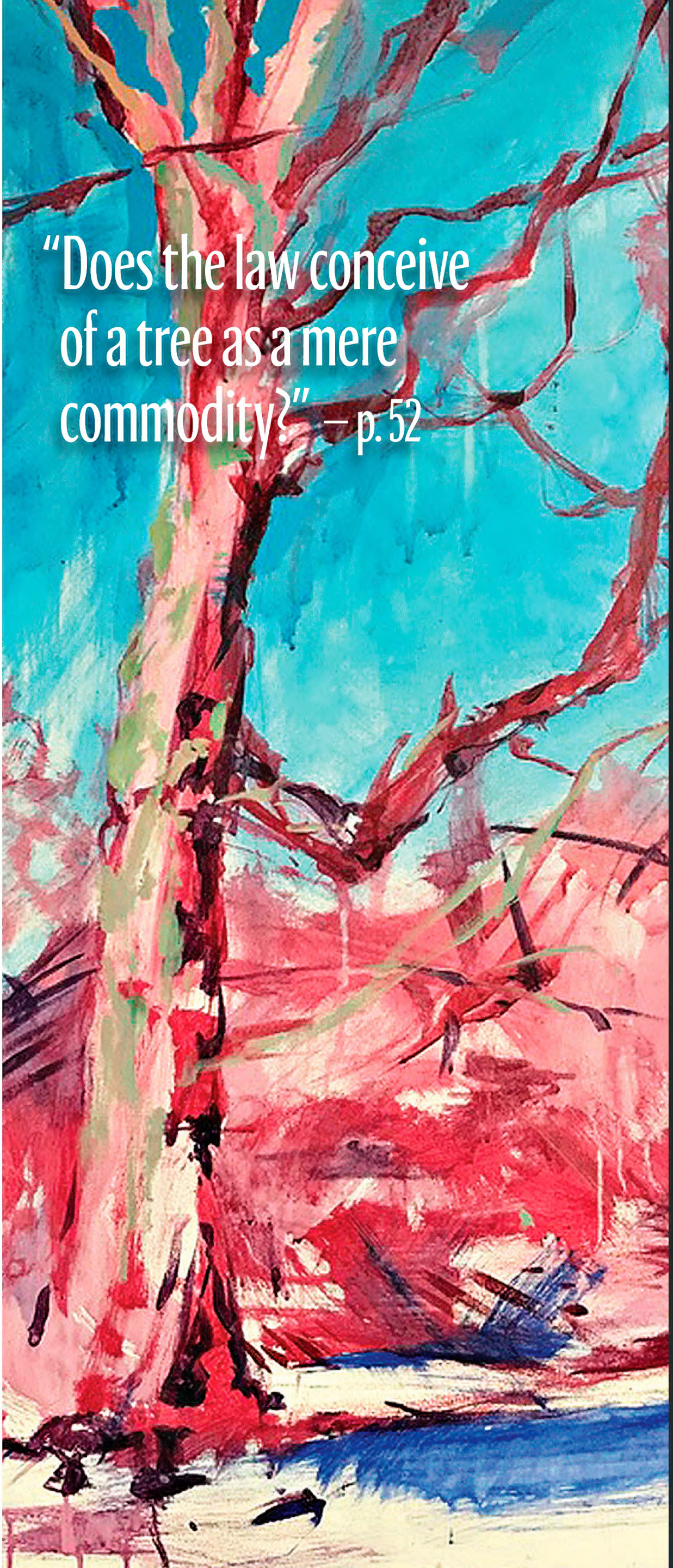
Plants in the Larz Anderson Bonsai & Penjing Collection.

2

Hours of nighttime freeze trigger the move to storage.

Frost is a fierce threat for containerized plants. Even the toughest trees are no match against frozen roots. Each autumn, the bonsai collection is carefully defoliated and brought indoors before the first 32-degree night. In cold storage, they are ushered into dormancy under controlled conditions. For four months, the living sculptures remain in darkness and suspended animation. Although dormant, blowing fans can still facilitate water loss from evergreen foliage. Each tree is watered every 7-10 days to ensure roots are both hydrated and insulated. At the end of winter, when light quality is still low, trees are transferred into a greenhouse where they gently re-animate. Some are re-potted, well before budbreak. Fibrous roots are precisely trimmed back to maintain the canopy's artificially stunted growth. After the threat of frost has passed, the refreshed collection returns to life in the public eye.

Hinoki cypress gets a lift into winter storage, courtesy of the author. *Photo by Matthew Battles*



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